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THE FINANCIAL SITUATION.

By Matthew Marshall,

Financial Reviewer of the "New York Sun."

IN the slang of Wall street the financial condition of the country is described by saying that "money is tight." There is plenty of it to be had, indeed, on call and on readily marketable collaterals, but, when it is wanted for any length of time and upon securities that cannot easily be sold, the case is quite different. When, as people say, "money is tight," it is not the money, but the owners of it who are thus described. Lenders have for the moment lost faith in the ability of their would-be debtors to pay their debts, and look with distrust and suspicion upon applications which previously they would have favorably entertained. The change in their feelings is part and parcel of the collapse in the New York stock market which has brought ruin upon so many adventurous speculators. Just as the public has passed from a state of mind in which it was ready to pay without hesitation the highest prices for fancy stocks, regardless of their intrinsic value, to one in which it will not buy them at any price whatever, so it has passed from a readiness to lend to anybody and everybody, on any kind of security offered, to one in which it will scarcely lend at all. Secretary Foster's silly bond negotiations last winter aroused fears in the public mind which have been intensified by the mysterious and vacillating policy of his Democratic successor; public confidence has been shaken; and, in their ignorance of the precise danger to which they were exposed, the great money-lenders have followed the course dictated by prudence, and, in order to diminish

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their own liabilities, have contracted their accommodations to borrowers. This has set in motion a process of liquidation, in the course of which, as in every struggle for existence, the weaker participants have gone under.

Since the beginning of February, when speculation in stocks was at its height, and confidence in everything and everybody was unbounded, up to the last of May the banks of New York lost in deposits $58,750,900, but in coin and paper money only $8,901,800. During the same interval they reduced their loans to borrowers $49,008,600, or $40,106,800 more than they lost in cash. This curtailing of loans by the banks here, large as it is, is but a part of a larger total to which borrowers all over the country have had to submit. Both financial institutions and individual lenders, in other places as well as in New York, have restricted their loans, and the consequence has become visible in the many failures which have been reported, both of corporations and of private persons. These failures are attributed to "tight money," but the real cause is a withdrawal of credit. The concerns which have become bankrupt were large borrowers, and had invested their borrowings in assets which were either valueless, or at least unmarketable. They were in the same situation as were the stock speculators who came to grief at the beginning of May. They had bought what they could not pay for, and suffered accordingly.

If Congress were in session, the prevailing difficulty of borrowing money would almost certainly lead to the introduction of measures for relieving it by increasing the supply of currency, and there would be plenty of eloquent speeches made in their behalf. But that the financial stringency is not due to any lack of circulating medium is proved by the fact that during the last four months $15,000,000 of additional Treasury notes have been issued for purchases of silver, under the Sherman act, and have gone into active circulation, while the gold that has been exported to Europe has been drawn mainly from the vaults of the Treasury, and not from people's pockets nor from the banks. On the other hand, that the stringency proceeds from the timidity of money lenders is demonstrated by the reduction of the volume of bank loans, as well as of those of individuals.

We are not alone in our misfortunes. The rest of the world is not only in a worse condition than we are, but it has been so for a much longer time. The Baring collapse in London, three years ago last autumn, benumbed, as it were, the whole continent of

Europe, and its effects are still far from having disappeared. The Argentine Republic, in which the Barings sunk so many millions of pounds of their own money and that of their too credulous countrymen, is to-day no better off than when its bankruptcy brought down the Barings. There is even good reason for fearing that the entire mass of Argentine securities held by the Bank of England against the £4,400,000 of Baring obligations which it joined with the other great London banks in guaranteeing will prove insufficient for the purpose, and that the associated guarantors will have to make good a large deficiency. The recent numerous failures of Australian banks are the outcome of a revulsion which began in the summer of 1890, and against which a struggle, proved by the event to have been unavailing, has ever since been kept up. Looking back from our present point of view over the course of events, it is rather surprising that we should not have taken warning from them and prepared ourselves for what has ultimately happened; but even in these days of steamers, telegraphs, and newspapers most people are so occupied with their own affairs that they pay little attention to what is going on in remote points, and only awake to a consciousness of disasters abroad when they feel their effects at home.

FINANCIAL depressions like the present are, as we all know, not infrequent, and, while each one of them has its peculiar characteristics, there are many features common to them all. They are preceded by seasons of great activity and apparent prosperity, and are followed by periods of comparative stagnation, out of which emerges another season of activity, to be followed in turn by another depression, and so on, over and over again. Evidently they have one general cause, and the attempts which are often made to account for them by reference to special agencies, and to devise special means for their prevention, are based upon a partial understanding of their nature. Thus, the advocates of free trade ascribe them to protection, and say that they would disappear if all protective duties were abolished. Free silver men assert that they result from making gold the single standard, and the speech of Senator Jones before the Brussels Monetary Conference elaborates at length this evil consequence of the demonetization of silver. Soft money men of the old greenback school say that an abundance of paper money is a sure safeguard against them, while orthodox gold monometallists see in our present evil plight only

the workings of the Sherman act. Allowing its full value to each one of these factors still leaves it unexplained why the alternations of buoyancy and depression which they are supposed to produce happen as well under free trade as under protection, in silver-using as well as in gold-using countries, under the reign of metallic money as well as under that of paper, and in places where there is no Sherman act as well as in that where there is.

A more complete and philosophical solution of the problem is found, it seems to me, in the constitution of human nature itself, which bears with impatience the dullness of a monotonous level, and rapidly passes from one extreme to another. Enthusiasm and despondency are equally epidemic. When prices are rising and profits, even though they are only on paper, roll up rapidly, everybody, as we have lately seen, is eager to buy ; but when, after this eagerness has evaporated and suspicion succeeds to confidence, the current turns the other way, everybody desires to sell, prices fall, and, until the remembrance of the losses thus incurred is obliterated by time, nobody is willing to make fresh ventures. This is what has just happened on our Stock Exchange. On a larger scale and in varied forms it occurs from time to time in every kind of business, and, when it occurs in all kinds and in many countries at once, it produces a world-wide depression such as we witness.

Take as an illustration the way in which the British money-lenders have behaved with regard to the Argentine Republic. Here is a country remote from the centers of civilization, embracing vast areas of land of which only a hundredth part is cultivated, and containing a population of not much over 4,000,000, a part of whom are Indians. Into this thinly settled wilderness British capital, from 1885 to 1890, was poured to the extent of $750,000,000 or $1,000,000,000. In return for it were received bonds of the republic and bonds of the individual provinces composing it, shares in banks, railroad companies, and water works companies, and an immense amount of obligations called *cedulas*, which were paper notes used as money and secured by mortgages upon land at the inflated valuation which the speculative fever produced. The upshot of the whole affair is that the country is now burdened with a public debt in various forms of $500,000,000, besides the debts of individuals and of private corporations, and has outstanding a paper currency of $300,000,000, depreciated to one-fourth or less of its face value. For 4,000,000 people, partly savages, this is a crushing burden, and their bankruptcy is not surprising. The

present state of things ought to have been foreseen by any reasonable mind, and, indeed, it was foreseen and predicted by many, but the British public, led by the Barings, would not be stayed in their mad career, and insisted on throwing away their money. That a revulsion followed in due time, and that a prolonged depression in Argentine securities should succeed to the avidity with which they were at first bought, was inevitable.

The depression in Australia is likewise a reaction from a senseless and excessive confidence in the wealth-producing capacity of a young and undeveloped country. The five colonies of Australia proper, namely, New South Wales, Victoria, Queensland, South Australia, and Western Australia, have in the aggregate a population of only about 3,000,000, and yet they have contrived to get credit in Great Britain, in one way or another, for nearly £150,000,000, or $750,000,000. In addition, it is estimated that the Australian banks have taken from British depositors on certificates of deposit bearing interest about £100,000,000, or $500,000,000, which, as fast as they received it, they proceeded to lend to speculators in real estate, while the money borrowed by the colonies and municipalities was lavishly expended upon railways, telegraphs, and public buildings and works. The flood of money thus suddenly let loose upon them set the Australians crazy. Real estate rose to fabulous prices, and the workmen in various trades, not content with the enormous wages they were getting, struck in 1890 for the exclusion of all competitors. This pricked the bubble, and ever since, as I said, the colonies have been struggling to avert a collapse which has just come. From a condition in which they enjoyed unlimited credit and could get all the capital they desired merely by asking for it, they have passed into one where they cannot even obtain a delay in the enforcement of claims against them for previous borrowings.

It is to be observed that in Argentina there has never been any lack of paper money, and that in Australia the gold standard has been rigidly maintained. We have had similar experiences in this country, each one under different conditions of coinage and currency, but each also following the same general course. The revulsion of 1837 took place under the reign of silver, that of 1857 during a prevalence of the gold standard, and that of 1873 when we had nothing but depreciated paper. Since then we have had several little collapses, like that which we are now witnessing, in which the currency is only an incident, and not the principal cause.

THE encouraging features of the financial situation are the activity manifested in the work of clearing away the wrecks of the various firms and corporations which have been forced into insolvency, and the good prospect discernible of their soon being able so to readjust their debts that they can resume the management of their own affairs. This cheerful coöperation of debtors and creditors in readjusting the burden of debts to meet the necessities of circumstances is a characteristic of modern civilized commerce, and especially of the commerce of this country. The debtor is no longer, as he used to be, the slave of his creditors; he cannot now even be imprisoned for failing to pay his debts, as he could both in Europe and in this country until not many years ago; he is viewed as being, in a sense, the partner of his creditors, and therefore entitled to divide with them the losses incurred through his want of skill or want of luck. Besides, it is seen that, as a live dog is better than a dead lion, so a customer in active business, with even moderate means, is of more benefit to trade than an idler whose hands are fettered by obligations which he cannot discharge, and who is a dead weight when he might be an active force.

Under ordinary conditions the prompt readjustment of debts after a collapse of credit such as we are now experiencing would produce a more hopeful feeling and restore business to its normal course. Debtors having made settlements with their creditors to the mutual advantage of both, confidence would at once succeed to alarm and distrust. It was thus that the panic of 1857 passed away, and that of 1860, complicated as it was by the war of secession, disappeared as soon as the nation saw the full extent of the task that lay before it and set earnestly to work to accomplish it. The troubles of 1873 lasted longer, but they, too, ultimately yielded to the efforts of enterprise and industry. Those of 1884 were of short duration, and so were those of 1890, though perhaps some of their consequences were never fully removed, and now remain to plague us. According to all precedent, therefore, we ought speedily to recover from the prevailing depression.

What renders it impossible to predict with confidence the usual happy result in the present instance is the uncertainty that hangs about the policy of the national administration and the legislation of Congress. The repeal of the Sherman act is viewed, in this part of the country, as the one thing alone needful to remove all cause of apprehension and permit business to revive. Whether the act has produced all the mischief that is attributed to it, and

whether it has not also, by averting other mischiefs, deserved a credit which it has not got, may be disputed ; but its workings hereabouts certainly inspire alarm and unsettle confidence. When the administration came into power, we were assured on all sides that the act would be repealed as soon as Congress could be got together, if it took all President Cleveland's influence and patronage to do it. Then we heard that a canvass was making of the new House of Representatives to ascertain the sentiments of its members in regard to repealing the act. Then an ominous suppression of the result of this canvass led to the unpleasant suspicion that it showed a majority of representatives against the repeal. Now we are informed that he is waiting for events to strengthen public opinion in favor of the repeal, and thus to compel a majority of members of Congress to vote for it.

It is the same thing with regard to the maintenance of gold payments by the Treasury. To this maintenance President Cleveland is committed, personally, by numerous utterances made both before and after his inauguration ; and public opinion, in this city at least, would sustain him in the exercise of even doubtful powers in preserving it. But his course on the subject has been perplexing, not to say vacillating. His secretary of the treasury, it is notorious, was ready to suspend the payment of gold on the Treasury notes of 1890, and had substantially, if not formally, issued an order to that effect. The president has the credit of countermanding the order, but no one who knows him will believe that it was issued without previously consulting him. Again, it was at first confidently asserted that bonds would be sold for gold to replenish the gold reserve as soon as it fell below $100,000,000, and figures were daily promulgated from the Treasury Department showing that the reason why bonds were not issued was that the $100,000,000 was still intact. At the same time an appeal was made to the banks throughout the country to come forward with their gold and make the issue of bonds unnecessary. Now the talk is that the reserve will be allowed to fall even to $50,000,000 before bonds are issued, and it is not asserted confidently that they will be issued then.

A similar uncertainty prevails in regard to the repeal of the prohibitory tax on State-bank circulation. The platform upon which President Cleveland was elected demands the adoption of this measure. It cannot succeed without his assent, and his opposition would probably kill it ; but whether he favors it or is hostile

to it has not yet been made known. The revision of the tariff, also, to which the party in power is pledged, is another disturbing financial factor, the full effect of which cannot be estimated until the extent and character of the revision are announced.

The mere announcement by the president that he intends to call Congress together in September and recommend it to repeat the Sherman act has had a reassuring effect upon the public. It has quieted alarm and inspired cheerfulness, and, coming as it did after the first spasm of depression had spent its force, it has stimulated the usual reaction from despair to hope.

For anything like the speedy establishment on a stable basis of our financial system there does not seem to me to be much reason to hope. The delusion that an abundance of currency means an abundant supply of money to every one who wants it is still far too prevalent to permit of the putting upon paper issues of the restrictions which sound principle dictates. The fundamental principles of finance, that an increase of the volume of currency reduces its value, and that currency of less value tends to drive out that of greater value, will have to be much more widely taught and accepted than they are at present before our legislators will act upon them. They must do what their constituents demand, and the demand is now, as it was during the prevalence of the greenback craze, for an abundant supply of circulating medium regardless of consequences.

Fortunately, the country is rich enough and strong enough to endure without irreparable injury the severe but effectual process of learning wisdom by experience. In fact, our very success in resisting and overcoming the mischievous tendencies of bad financial and economical legislation delays our progress toward a true system. As a strong, healthy young man can for years defy the laws of health and the warnings of his physicians, and in his eating, drinking, and course of life can do with impunity many things which, according to precedent, ought to kill him, so we have been going on in financial matters disregarding the experience of other nations without as yet incurring the natural penalty of our sins. But this immunity cannot be expected to last forever. Sooner or later the laws of finance, like those of health, will vindicate themselves, and our people are intelligent enough, it may be presumed, to learn from results, at least, what they cannot be taught by warning and prophecy.—*The New York Sun.*

LIMITS OF THE NATURAL-GAS SUPPLY.

By S. S. Gorby,

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MATTER is known to occur in three forms,—solid, fluid, and gaseous. Gas is matter in the most extreme state of tenuity known to man. Of the various kinds of gas, some are heavier and some lighter than air. By nature's processes matter is changed from the solid to the fluid or gaseous state, and *vice versa*. The process of changing matter from the solid to a gaseous state is one of decomposition. The change from a gaseous to a solid condition is the result of a combination of elements. All gases with which men are familiar, excepting, of course, common air, are the result of the decomposition of solid or fluid matter. In a commercial sense there are two kinds of gas, natural and artificial. Artificial gas is that produced by methods in which the decomposition of matter is hastened by the artifices of man. Natural gas is that in which the accident of position has led to its production by the decomposition of matter in obedience to natural laws. The substances from which gas is derived are the same in both instances. Technically speaking, all gas is natural gas. With reference to artificial gas, man's knowledge of nature's processes enables him to place the gas producing material in such a position as to hasten decomposition, and he applies the husbanded product to his own use. By artificial means the process of gas generation is hastened, but the product derived is the result of the operation of the same laws that operated in producing the stored gas of the widely known fields of Indiana, Ohio, and Pennsylvania.

With reference to the substance commercially spoken of as natural gas, and understanding that it is a product of decomposed matter, the next thing is to determine the kind of matter from which it is derived. Matter is of two kinds, organic and inorganic. The natural gas of commerce is confined in various kinds of rocks, which are inorganic. The presumption is that this gas originated in the rocks that confine it. If the gas originated in the rocks that now confine it, it must be the result of chemical changes that have taken place in the rocks themselves since their deposition. Without geological evidence the presumption would be strong that the

gas is of inorganic origin, as some maintain ; but geological investigations have disclosed that the rocks that form the various gas reservoirs contained, at a very remote period, vast quantities of organic matter, both animal and vegetable. This organic matter was deposited with the sediment in ancient sea bottoms, just as vast quantities of organic matter are being deposited to-day in the mud at the bottom of our existing seas. It is well known that, when organic bodies, either animal or vegetable, are deposited upon land, or in shallow waters, or are buried slightly beneath the land surface, decomposition immediately begins. The combination of elements is broken up, and complete dissolution of the body is the final result. The gases that are generated escape into the atmosphere, and these, as a rule being lighter than common air, are lifted by the heavier body to an altitude where the tenuity of the air equals that of the gas, where, it is reasonable to assume, a complete separation of the elements that form the gas occurs, and the separated atoms of matter fall back to earth to enter into new combinations. But when a body is deposited in deeper waters, the air is excluded, and it may remain for a long period before chemical changes occur in the tissues. It is soon covered with the silt of the sea. This fine mud, impervious to air, continues to accumulate, as other organic bodies are deposited, and the process of decomposition may be arrested, or measurably retarded, for ages. The accumulations of silt and other matter continue to increase, until finally there is a sufficient weight of superincumbent matter to wholly confine the gas that may be generated.

To illustrate : There is a vast body of water just north of the equator in the Atlantic ocean, known as the Sargasso sea. This is in a region of comparative calm so far as winds and oceanic currents are concerned. This vast space, hundreds of miles in extent, is full of great masses of floating seaweed. It is not uncommon to find solid masses of these marine algæ covering areas of seven or eight hundred square miles. Some species of these seaweeds are of gigantic size. They grow at the surface of the water and are continually sinking to the bottom of the sea, where they are mixed with the silt and more or less animal matter. When the deposition of this organic matter ceases, the accumulations of silt will steadily increase until the whole mass of vegetable matter is buried hundreds of feet in oceanic mud. Later on chemical changes will occur in the silt, itself, as well as in the buried mass of vegetation. The mud will become indurated, and finally hardened into shales,

or other forms of rock. By natural process the vegetable matter will be changed into peat or coal; or, if the process of decomposition is more rapid and complete, the final result will be oil fields and gas areas. Many of the processes of nature are inconceivably slow, and man cannot estimate the time required to produce a geological formation except by ages of indefinite extent. Years and centuries in this connection become as mere seconds of time. These apparently slow processes will be continued without intermission century after century, until finally a great geological formation is built up, and the ocean itself is shifted to another quarter of the earth.

This shifting of oceans and seas has continued for measureless ages. The land areas in which our gas-fields lie were for inconceivable periods beneath broad seas. The rocks at the various gas horizons, and those above and below them, are full of the remains of organic bodies similar to those that inhabit existing seas. Thousands of species of shell-fish have been identified, but how many thousands of species once existed of which no trace has ever been discovered is wholly beyond conjecture. It is enough to know that these fish existed in some waters in such vast quantities that the oyster-beds and mussel-shoals of the present day are insignificant in comparison with them. In hundreds of places where limestones occur masses of the stone, dozens of feet in thickness, are composed wholly of the perfect or comminuted shells of ancient orders of these fishes. In fact, almost the entire limestone formation of the globe is composed of the comminuted shells of these denizens of ancient waters. It is reasonable to assume that the softer portions of these animals contributed largely to the stores of gas and petroleum found in our limestones. In addition to these, countless myriads of crustaceans swarmed in the waters of the ancient oceans, besides other orders of animals innumerable. Some of the rocks disclose vertebrate remains, such as fishes and reptiles, in such vast quantities that they compose almost the entire body of the rock. Such for instance are some of the phosphate-beds of the south.

Besides the animal remains found in the rocks, there are found vegetable remains that indicate a profuseness of growth in this kingdom far surpassing the product of the richest forests and jungles of the tropical regions of to-day. Many of the seas were filled with a plant growth similar to the seaweeds of to-day. Remains of these are found profusely through the rocks. Evidences of

these plant growths are found in greater or less abundance in all the stratified rock deposits. All the great coal deposits of the earth are but partially decomposed portions of the wonderful vegetable growth of past ages.

More or less mineral matter enters into the structure of all animal bodies. The shells of oysters, crabs, and turtles, and the bones of animals, contain a greater proportion, and these are the parts that are universally found in a fossil state. The softer parts of the body soon decompose, and the gaseous portions are dissipated in the air, or confined in some reservoir. Trunks of trees are more readily preserved, and these are found in all states of preservation, from the semi-lignitic state to that of pure coal.

Coal is found in various states of preservation. In the process of decomposition we have wood, peat, lignite, bituminous coal, cannel coal, and anthracite. The last, anthracite, is virtually natural coke. It was once bituminous coal, but in nature's laboratory, or oven, it has been converted into anthracite by slow processes, but by the same laws that govern when bituminous coal is placed in the cooking oven. Coke is artificial anthracite, just as the gas evolved in a cooking-oven is artificial gas. The texture of anthracite was modified by the condition of environment and the weight of superimposed strata during the process of gas elimination.

The preceding statements have been made for the purpose of showing that great masses of organic bodies, both animal and vegetable, capable of yielding gas in unmeasurable quantities, were distributed throughout all the stratified-rock deposits during the rock-building periods of the past. Gas and petroleum have been found only in the stratified-rock deposits. They are never found in the granites or in other igneous rocks that are barren of organic remains. The sedimentary, or stratified rocks of the various oil and gas areas lie over the igneous, or non-stratified rocks. If gas was generated in the lower rocks, it might readily by its expansive force propel itself into reservoirs in the superincumbent strata, but petroleum would not ascend unless forced upward by hydrostatic pressure. But in face of the fact that neither gas nor oil have ever been found in the igneous rocks, none will care to assume that petroleum has been forced into its position in the superlying rocks by pressure such as suggested above.

Assuming that natural gas was generated in the rocks that now confine it, an examination of these rocks and contiguous rocks

ought to determine as to the probability of the gas having been produced by a partial dissolution of the rock structure. Careful analyses of the gas-bearing rocks of Ohio and Indiana have been made from time to time, and it has invariably been found that the samples examined have undergone no material chemical change. In some localities the rock that forms the reservoir is a nearly pure carbonate of lime. In other localities it is a sulphate of lime or magnesian limestone. In all cases it is crystalline, or semi-crystalline, in structure. There has been no general decomposition of this rock or of that contiguous to it. The rock is composed of small crystals of lime with interstices between that form the so-called "pores" in which the gas is confined. The capacity of the reservoir is determined by the size of these interstices, the thickness of the rock, and its lateral extent.

With a knowledge of the fact that there has been no material change in the component elements of the rocks at the gas horizon, and the knowledge, also, that the underlying igneous rocks are barren of gas and have not the elements to produce it, it is easy to arrive at the conclusion that natural gas has been derived from the organic matter that was buried with the sediment that now forms the rocks. This is equally true of the gas found in Pennsylvania and West Virginia, as well as that of Ohio and Indiana.

Another fact in this connection is that all geological formations from the Trenton group, upward, contain more or less gas and more or less petroleum. This is important considered with the fact that all of these formations and groups of rocks are full of organic remains. The Utica shales, overlying the Trenton limestone in Ohio and Indiana, have a maximum of thickness of 400 to 500 feet. They are usually black and are in places highly bituminous. The Niagara limestones in Indiana, Kentucky, and Tennessee contain more or less petroleum distributed almost universally through their strata, and in some localities considerable deposits of asphaltum occur. The Devonian shales of Tennessee, Kentucky, and Indiana are rich in petroleum, but as a rule they lie so near the surface that the oil has largely evaporated or changed into gas, and has been dissipated in the air. In Meade county, Kentucky, and Harrison county, Indiana, the limestones underlying the Devonian shales yield gas in paying quantities and also petroleum to some extent. Petroleum is mentioned in connection with natural gas for the reason that they are uniformly associated in the rocks or are found contiguous to each other, and it is as-

sumed they both have the same origin. In fact petroleum is the residuum of natural gas, just as asphaltum in many places is known to be the residual matter of evaporated petroleum. Petroleum is the only element now left in the rocks from which the supply of natural gas may be replenished.

The fact seems plain that natural gas is of organic origin, though it may be remotely so. First petroleum is distilled, and following, possibly, gas is generated. This being true, why do not all areas where stratified rock occur have natural gas? First, because over many areas where organic matter was deposited in large quantities the conditions were such that immediate decomposition took place and the gas escaped into the air. Second, in many large areas where gas was generated, probably in immense quantities, subsequent disturbances fractured and fissured the strata to a great depth, thus releasing the imprisoned gas from its reservoir. Then, there were doubtless large areas of the ancient oceans almost barren of organic life, just as portions of existing seas are almost destitute of life, and these areas are naturally destitute of gas and petroleum in paying quantities. The meaning of "sedimentary" and "stratified," when applied to rock formations, is generally understood. It is known that these are the rocks that were formed by deposition in seas and other bodies of water. The matter composing these rocks was first deposited as mud, sand, or gravel. The rocks derived from these depositions form shales, sandstones, and limestones, with various minerals interspersed through them. It is doubtless true that mechanical and chemical action both contributed to produce the transformation from mud and sand to stone. It was during this period of metamorphic action that the petroleum confined in the rocks was distilled and the natural gas generated from the decomposing organic matter. The organic matter confined in the sediment during the period of metamorphic action was wholly decomposed. Nothing remains of it except the mineral portion. There is no further store upon which nature can draw to replenish the oil and gas fields when they are once exhausted. Ultimate exhaustion is an absolute certainty. The gas reservoirs will become as barren as will the coal fields when the coal has all been mined.

Natural gas in commercial quantities is confined to limited areas, and, necessarily, it is limited in amount. As already stated, there is but one source from which the exhausted areas may be replenished and that is from the petroleum confined in the same rock

reservoirs. The conditions that prevail in the strata containing the petroleum are not favorable for a a rapid generation of gas. The temperature of the rocks is too low. The temperature of the water in the deep wells of Ohio and Indiana is never found to be above 60° F. The average temperature of the water in the deeper wells is about 55°. This is much too low to produce a rapid transformation of petroleum into gas. It would require a temperature at least three times as high to produce a rapid generation of gas. The stock of gas now confined in the various reservoirs is all that can ever be made available for use. Even if there was a sufficient generation of gas from petroleum to keep up the normal pressure in the wells and mains, the stock of petroleum would finally be exhausted, and then the supply of gas would as certainly cease.

This one important fact is plainly apparent: The supply of gas for practical use is certainly limited. How long it may be made available for economic purposes must be decided in the future. Its permanency depends largely upon the use made of it. For the past eight years it has been extravagantly and foolishly wasted. For a period of nearly one year there was a daily waste in the State of Indiana alone of more than 100,000,000 cubic feet. The daily loss to the people of Indiana on account of this enormous waste was more than $10,000. It is estimated that 30,000 cubic feet of gas in the Indiana field is equal to a ton of the best coal in stoves or furnaces. Coal delivered in the Indiana gas-fields is worth $3.25 per ton. It is not an extravagant statement to assert that the cash value of natural gas wasted in Indiana since its discovery would be more than $20,000,000,—an amount greater by far than the total capital invested in these fields on account of cheap fuel. The waste is still going on at the rate of 25,000,000 cubic feet daily. Hundreds of flambeaus, consuming on an average 2000 cubic feet of gas per hour, have been allowed to burn day and night, without interruption, ever since the beginning of developments in the gas area. Hundreds of unprofitable wells are not plugged, but are left wide open and the gas allowed to escape into the air. This is especially true of the section of the field where petroleum is found in connection with gas. Scores of isolated wells that have been drilled for oil yield gas in large quantities, but they are not connected with pipe-lines, and the oil is saved, but the gas permitted to waste. Reckless extravagance also prevails in the use of gas, both in factories and private houses. Gas, in the Indiana field, is not sold by measure, but it is supplied for factory or

domestic purposes at a fixed price per month. It makes no difference whether much or little is consumed, the price is the same. It costs no more to continue the fires twenty-four hours in the day that it does one hour. With this state of things existing the consumer has no interest in practising economy. Fires are allowed to burn continually in unoccupied rooms and unused furnaces, without regard to the value of the fuel consumed. If gas were sold by measure for all purposes, consumers, especially, would practise economy. The statement may seem extravagant, but it is doubtless true that at least 40 per cent. of the gas consumed in the Indiana field, factories, dwellings, etc., is actually wasted.

But one result can follow this extravagance, and that is a quick exhaustion of the field. A final exhaustion is inevitable, under any circumstances, but the profligacy that now prevails is destroying the field at a two-fold ratio. With economy in its use natural gas will bring capital and prosperity to the field for years to come, but the quick exhaustion that will surely follow the extreme prodigality of the past few years will necessarily result in the abandonment of the field, to a certain extent for manufacturing purposes.

Gas is most beneficial when consumed for domestic purposes. In this way it benefits a much larger proportion of the population, and there is also more profit to the producer in selling it for domestic use. As the volume of the supply gradually decreases, it will necessarily be withdrawn from use in the factories and the supply confined exclusively to domestic use.

It is well to note that at this time there is a united action on the part of the various companies producing natural gas throughout the various fields looking to its preservation, and endeavoring to secure rigid economy in its use. If these efforts are successful, the period of prosperity now prevailing throughout the gas areas will be materially lengthened.

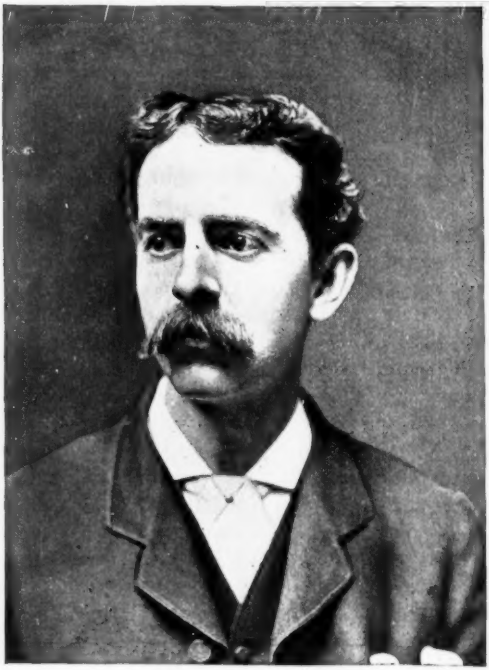
SCULPTORS OF THE WORLD'S FAIR.

By J. H. Gest.

WHATEVER may be the success of the World's Columbian Exposition as an exhibition of the liberal and mechanical arts, or of natural products, it has achieved in one respect a result that could not reasonably have been expected, and certainly could not have been foreseen in its actual magnitude. In 1889 France presented to the world an architectural and artistic spectacle unapproached by former exhibitions, and until within a few months past the last French exhibition remained the ideal in the public mind. Almost no one had thought of an American exhibition which in the architectural beauty of its buildings, and especially in their sculptural decoration, should in any way rival Paris of 1889.

Conceding the ability of our architects to carry out their part of the task, where were the sculptors capable of acceptably decorating the buildings? To do this work required not only one man, or a half-dozen men, but a score or more of trained sculptors supported by a corps of personal assistants, and a small army of subordinate modelers and molders. They must be men fertile in the invention of a kind of ornament for which comparatively little use has hitherto been found in this country,—not men capable of modeling merely detached statues, but able also to do it in harmony with architectural surroundings. This aspect of the sculptor's art is almost entirely unknown to the Americans as a people, who for want of knowledge have really no conception of its uses and its value in civic and national life. Even those of us who have occasionally the good fortune to travel in Europe, and who bring back in memory, and in photographic scrap-books, impressions of the architectural and sculptural interest of European towns large and small,—even they drop back into the practical course of the overpowering commercial and mechanical movements peculiar to our civilization, and ere long become content with the bald surroundings of brick and stone amidst which the large percentage of our population live and labor. If even these favored few do not sufficiently value the presence of beauty of sculptural form as a leaven in the hard commonplace of our cities, how can the less fortunate, to whom this beauty is as unknown as though it had no existence?

It may be asked: What is the value, to a civilization like ours, of the esthetic expressions in form which are the products of the sculptor's art? Some years ago esthetics seemed entirely apart from the proper course of our lives. The usefulness of art was practically unknown, and even recreation was indulged in either under compulsion or with an unhealthy excitement. It is now generally admitted that of all the means of mental recreation none are so nearly inexhaustible as art, and in none can the restful influence be so ever-present. This is acknowledged in our strenuous efforts to introduce beauty into the most humble of the industrial arts, which is the marked characteristic of our industrial advance since 1876. All of this reaches the homes of the people and introduces an esthetic leavening of growing force. Art museums and galleries of paintings and sculpture are carrying the movement forward on a higher plane. But we have just begun to appreciate the fact that buildings, public and private, should themselves teach the value of beauty of proportion, of mass, of form in outline and surface, and even of color. Here the sculptor's work joins that of the engineer, architect, and builder. When the capitalist has employed the engineer to plan his enterprise, the architect to give his building not only adaptability to its use but



DANIEL CHESTER FRENCH.

"INDIAN CORN."
[By Daniel C. French and Edward C. Potter.]

also a character that shall be its entity as compared with others, then steps in the sculptor to ornament, until the whole shall possess not only utility but a beauty which shall make acceptable and perhaps emphasize that very utility. The finished work is thus by its attractiveness made even more efficient for the purpose for which it was intended. Other things being equal, the increased rental of the building will pay the interest on the cost of the sculpture. And the city with fine public squares, artistically dressed with statuary in appropriate architectural settings, will thrive as compared with the rectangular, monotonous, bald, utilitarian town, provided the location and other commercial conditions be not too unfavorable. Further, this ornamentation of a city stimulates its pride,—a force constantly active in advancing a community. The streets should, so far as public and private enterprise can make them, be as popular museums full of object lessons that will tend to make

QUADRIGA—"THE TRIUMPH OF COLUMBUS."

[Figures by Daniel C. French; horses and herald by E. C. Potter.]

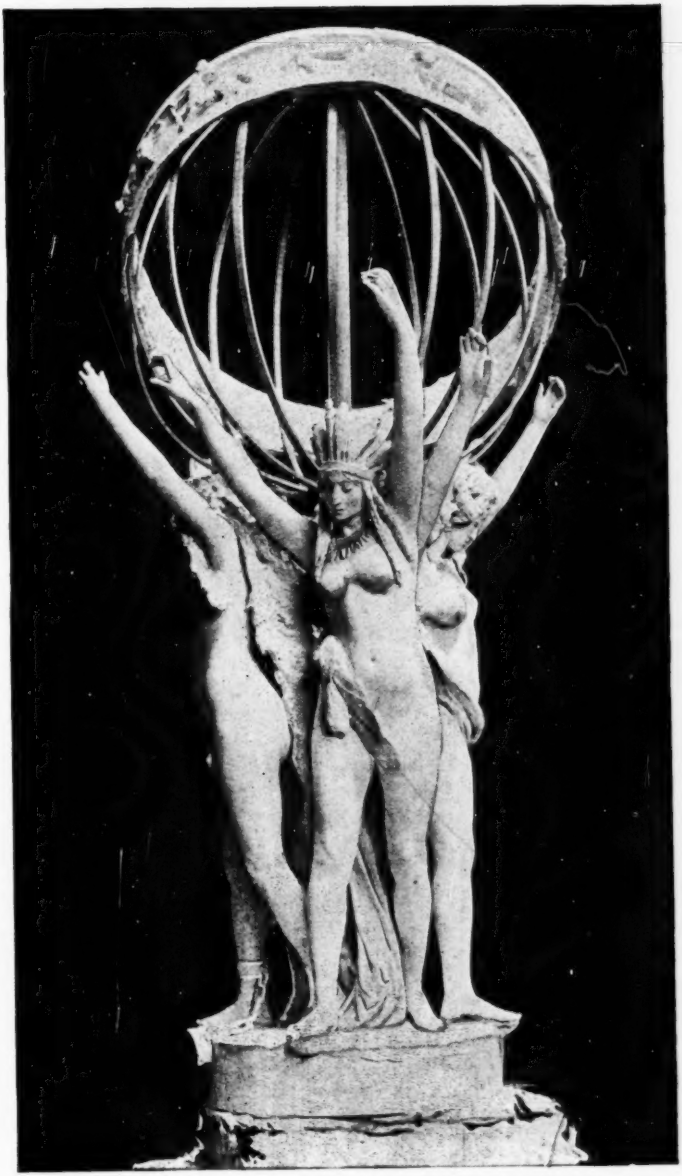
HERALD OF THE QUADRIGA GROUP.

good citizens. One of those lessons is the evidence of thrift given by the bustling crowd, another is the stability of buildings, but still another should be the appropriateness and the architectural and sculptural beauty of these same buildings. All this provision for his enjoyment of life tends to add something to the capacity of the citizen for activity.

There is no doubt as to the impression that will be made upon thousands of visitors to Chicago this year. The beauty of grand buildings harmoniously grouped in Jackson Park, the charm of decorative sculpture, the richness of public places and avenues abounding with statuary, create an unsuppressable longing that something of this, apparently so permanent, yet really so temporary, may remain as a lasting impression upon our people. While not attempting to distribute the credit for the beauty of these buildings and grounds, we may well recall that, when the use of Jackson Park—then largely swamp-land—was under discussion, it was Frederic Law Olmstead, the landscape architect, who conceived the plan of dredging lagoons and canals to secure sufficient earth for fills upon which to place the buildings, thus meeting the practical demands of the occasion, and providing the opportunity for artistic effects of land and water. Then followed the grouping of the buildings, of which much was prompted by Mr. Root, though conferences among the chosen architects led to the arrangement finally worked out, and to the adoption of the prevailing style of classic architecture. Coming to the sculptural ornamentation of the buildings and grounds, we should probably find Augustus St. Gaudens the dominant power, though his own work is limited to the gilded "Diana" on the main dome of the Agriculture building, whither it was removed from the tower of the Madison Square Garden, New York. These names, coupled with that of D. H. Burnham, the director of works, are those one hears from all who speak of the enterprise.

So extensive has been the use of sculpture that its enumeration in detail is out of the question in a single magazine article. All that can now be done is to convey a general idea of its character, and to urge upon the visitors to Chicago a more exact examination of it, especially from the point of view presented in the preceding pages.

While the buildings throughout have been beautified more or less by the judicious use of architectural ornament and sculptural decoration, it is about the great basin that we find the sculpture



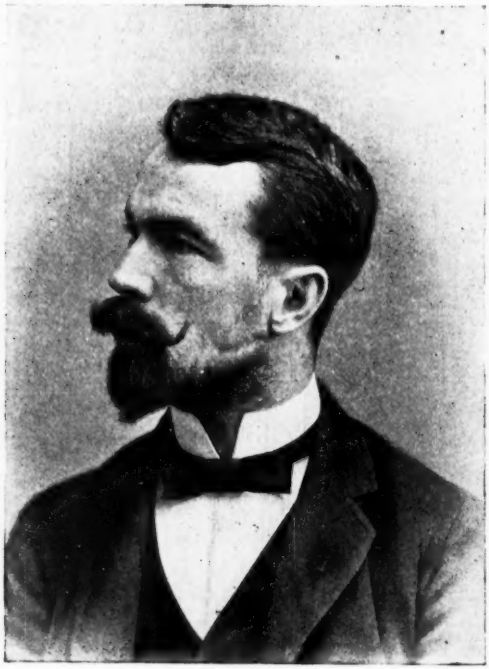
"THE FOUR RACES SUPPORTING THE HOROSCOPE" ON TOP OF THE AGRICULTURE BUILDING.
[By Philip Martiny.]

most abundant. It would seem as though architects and sculptors alike had striven their utmost to demonstrate here the value and the resources of their combined art. This main court, or plaza, of the exhibition extends from the lake toward the west about 2000 feet, and is 700 feet wide. Its eastern portion contains a basin 1100 by 350 feet, which terminates toward the west in front of the Administration building, while the court extends beyond this to the railway terminus. The most important of the exhibition buildings line this court, passing the Administration building on either side, and enclosing the great basin toward the lake. At the lake end a peristyle with four rows of pillars and sixty feet high connects the lateral lines of buildings, while from the centre of the peristyle rises to a height of 150 feet the Columbus arch, upon which has been placed the colossal Quadriga group by Daniel Chester French and Edward C. Potter, his pupil. The figures in this group are twelve feet tall and the plinth measures forty feet. It represents the Spirit of Discovery, Columbus entering in triumph in his chariot, the horses led by graceful maidens, the whole flanked by two heralds, boys carrying standards. The figures of Columbus and the two maidens are by French; all the horses and the boy heralds are by Potter. The first impression is one of dig-

PHILIP MARTINY.

GIRL HOLDING A SIGN OF THE ZODIAC—AGRICULTURE BUILDING.
[By Philip Martiny.]

nity, produced by the fine lines of the composition and the noble beauty of the figures, after which one realizes the great vitality of both figures and horses, which, though restrained, are full of action. I do not know anything finer in modern monumental sculpture than the Quadriga and French's truly colossal "Statue of the Republic" rising from the basin some distance in front of the arch to a height of one hundred feet, the statue itself being sixty-five feet tall. The Quadriga upon the high arch in the peristyle forms really the background for the "Statue of the Republic," and the two must be considered together.



KARL BITTER.

"The Republic" is a statue of exceeding dignity, tall, stately, with serene countenance, beautiful in a grand abstraction that finely symbolizes the noblest aspects of our national character. I cannot speak too highly of the monumental grandeur and beauty of the "Republic" and the "Quadriga." In addition to these French and Potter have modeled four colossal groups for pedestals on the roadways on either side of the basin in front of the Agriculture building and the Manufactures and Liberal Arts building on the opposite side of the water. The figures are twelve feet high, and the animals in proportion. The subjects are an Indian maiden standing beside a bull, typifying "Indian Corn," and another maiden

GROUP ON TOP OF ADMINISTRATION BUILDING.
[By Karl Bitter.]

also beside a bull, representing "Wheat." On the opposite side of the basin a "Young Farmer" stands near his horse, and the "Negro Teamster" is similarly placed. Each group being repeated, there are eight in all. Unpretentious, in quiet easy action, or in repose, these groups are heroic with a certain latent vigor.

Daniel Chester French is of New England extraction, born in Exeter, N. H., in 1850. In boyhood, at Concord, he became interested in modeling in clay, through the kindly attention, it is said, of Louise M. Alcott. For a short period he studied under Dr. Rimmer, the well-known anatomist and lecturer. In 1870 he became a pupil of J. Q. A. Ward. As Mr. W. Lewis Frazer says, he "did not go abroad until his style was formed, and he had seen one of his own works (the statue of 'The Minute Man') erected at Concord Bridge in 1875. In fact the whole period of his foreign art-study is covered by the two years spent in the studio of Thomas Ball in Florence and one year in Paris." In addition to the "Minute Man" (1874), may be mentioned "John Harvard" (1883), "Lewis Cass" (1887), "Dr. Gallaudet and his First Deaf-Mute Pupil" (1888), "Thomas Starr King," "The Angel of Death Staying the Hand of the Sculp-

tor" (Milmore memorial, 1891), for which he received a third-class medal in the Paris Salon.

The name of Edward C. Potter naturally follows that of his master, Daniel C. French, on account of their close connection in the Quadriga and other groups. Potter is a young man, born in New London, Conn., thirty-five years ago; studied in the school of the Museum of Fine Arts, Boston, and simultaneously with French. Later he worked in Paris under Frémiet and Mercié. His present commissions in Chicago are really the first important ones executed by him, but their great excellence should lead to the immediate recognition and rapid advancement of this vigorous young artist. They are the Heralds of the "Quadriga," horses and boys, the four other "Quadriga" horses, and the cart-horses and bulls. He also has on the New York building two lions after the antique. In the Art Institute is a "Marble Faun" and in the Senate chamber at Washington a bust of Vice-President Wheeler, by him.

LORADO TAFT.

I have dwelt at some length upon the work of French and Potter because of the prominence of its position as really the key to the

PORTAL OF HORTICULTURE BUILDING, SHOWING "SPRING" AND "AUTUMN" GROUPS.

[By Lorado Taft.]

scheme of sculptural decoration of the main court. The other most important detached work of sculpture is the great fountain at the west end of the basin, opposite the "Republic" and "Quadriga." This Columbia fountain, one of the largest in the world, occupies a circular basin about 150 feet in diameter, directly in front of the Administration building. The composition is an embodiment of the spirit of modern liberty. Seated high upon a triumphal barge,

CARL ROHL-SMITH.

Columbia is rapidly driven forward by eight standing oar-maidens, representing the arts on the one side, and, on the other, the sciences, industry, and commerce, while the herald Fame stands at the prow and Time at the helm. Sea-horses without-riders form a circle in front, and surrounding dolphins cast up jets of water. The figures are over twelve feet in height. On the sides rise fifty-foot columns surmounted by eagles. It will be seen at a glance that the spirit of the composition is movement, and this idea the artist has expressed in charming variety and freshness of form, preserving at the same time in the pose of the figure of Columbia a suggestion of a fixity of purpose. It is regretted that a satisfactory view of this fountain cannot be presented here, as it is a very important work in

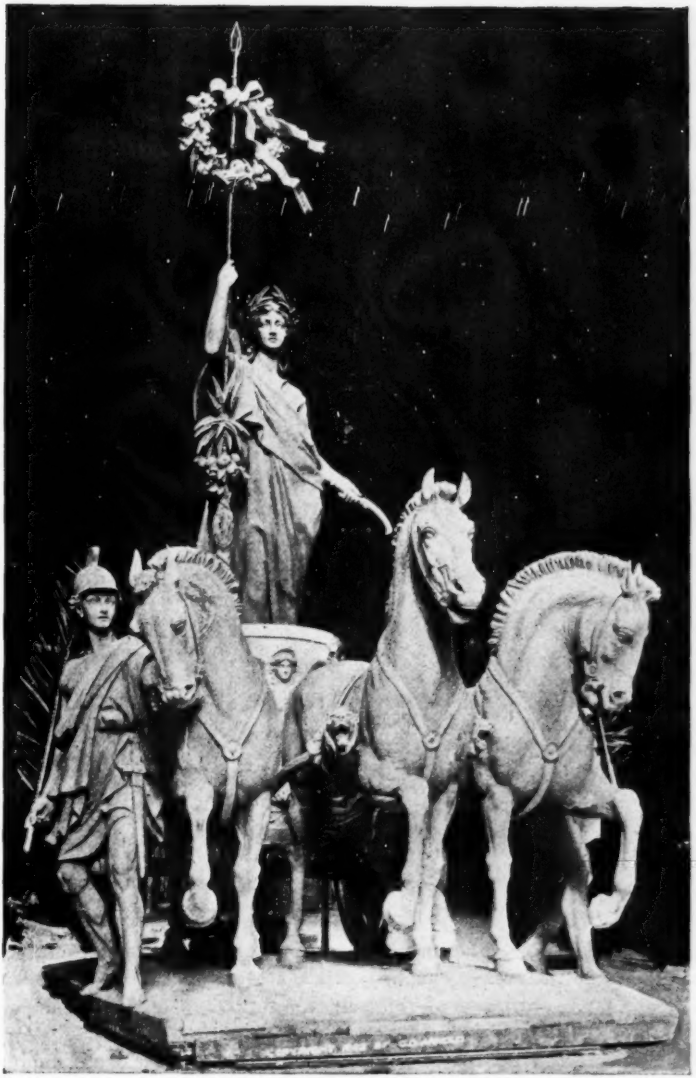
STATUE OF "THE REPUBLIC."
[By Daniel Chester French.]

the present development of modern sculpture. Frederick MacMonnies is a young man, of native birth, and received his preliminary training under St. Gaudens in New York. Since then he has been in Paris for some years, and has attracted by his work in the Salons the frequent notice of artists.

To another pupil of St. Gaudens was entrusted the decoration of the Agriculture building, one of the most prominent in position and therefore requiring exceptional skill and thought in its decoration. I refer to Philip Martiny. Born in Strasburg of French parents in 1858, he came to this country to escape conscription. He had from the age of fifteen worked at modeling, studying first with Eugene Doch. In New York he became a pupil of St. Gaudens, and afterward assisted him in various undertakings. Among his works are the bronze medal of Washington, for the Washington centennial, New York; the spandrels of the Brooklyn arch; and the proscenium panel for the Madison Square Garden; and he is now executing a commission for the Art Institute building, Chicago.

M. A. WAAGEN.

The sculpture on the Agriculture building has, of course, been made appropriate to the intention of the building. It is all by Martiny, with two exceptions,—namely, the "Diana" by St. Gaudens on top of the central dome, and the pediment group, "Triumph of



GROUP ON COLONNADE BETWEEN THE AGRICULTURE AND MACHINERY BUILDINGS.
[By M. A. Waagen.]

Ceres," by Larkin G. Meade. On the pavilion domes Martiny has placed a beautiful group of four female figures representing the "Four Races Supporting the Horoscope." On the four corners of the building are groups of three seated female figures holding aloft garlands. They represent the seasons. The eight main piers are surmounted by finely-composed cattle groups, either a woman standing between two cows facing out, or a man between two horses in similar pose. The small pediments are also filled with sculpture. Then, on each of the piers all the way round the building, stands a stately female figure holding aloft a panel bearing a sign of the zodiac. There are also fifty-two figures of "Abundance" repeated as an ornament about the façade of the building. Consider in connection with this the architectural beauty of the building in design, and the subordinate ornament in moldings and various kinds of relief modeling, and one may form some conception of the richness of effect. There is in Martiny's work a classic grace, an appreciation of refinement in form and of line in composition, that give it a subtle charm.

JOHN J. BOYLE.

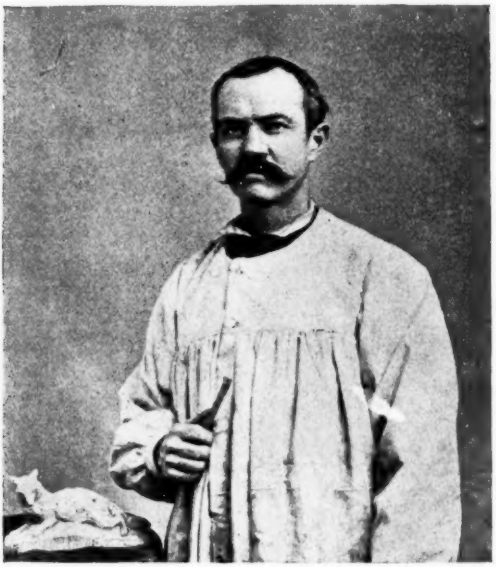
Larkin G. Meade, referred to above as the sculptor of the main pediment of the Agriculture building, was born in New England in 1835, and has for many years occupied a prominent position

"FIRE UNCONTROLLED"—IN PORTAL GROUP ON THE ADMINISTRATION BUILDING.

[By Karl Bitter.]

among our older sculptors. Since 1862 he has passed the greater part of his professional life in Florence, Italy. Among his important works is the statue of Lincoln for the national Lincoln monument, Springfield, Ill. The present pediment group is "The Triumph of Ceres."

Another of the notable buildings is that devoted to Administration, the prominent location of which has already been referred to. On this account its sculpture was planned on the most liberal scale, and the sculptor selected for the task is Karl Bitter, whose work is characterized by unusual spirit and vitality. Whether we view it as symbolizing the tireless activity of our American life, or the indomitable enterprise of Chicago and its World's Fair, the decoration of this building is equally appropriate, and in that sense it takes its place well with the other sculptures of Jackson Park.



EDWARD KEMEYS.

Its very exuberance has a reason for existence in Chicago. Large groups of statuary and colossal single figures are placed at the base of the tall octagonal dome, and on the corners of the pavilions, to connect the dome with the rectangular mass below, while other groups enrich the portals. At these entrances the four elements give subjects to the compositions. On the pavilions are represented national characteristics, such as heroism, love of liberty, etc. At the point from which the dome springs are allegorical groups representative of culture,—"Art," "Science," "Industry," etc. This will convey some notion of the spirit of the sculptor's art.

Karl Bitter was born in Vienna, Austria, in 1867, studied there in the Kunst-Gewerbe Schule and the Imperial Academy, and worked upon the sculpture of the new Imperial Museums. In New

York for about four years he has been commissioned to make the principal of the Astor memorial gates for Trinity church, has executed figures for George Vanderbilt's gallery, caryatids for the Belmont tomb, and marble figures for the Vanderbilt house at Newport.

The Manufactures and Liberal Arts building, with its great roof, has consistently been kept simple in character, the façades broken only by the low arches of the encircling colonnades and the high arches at the portals. These latter have spandrels by Karl Bitter, who also modeled the mammoth eagles upon the col-

CROUCHING ANIMAL, ON A BRIDGE ABUTMENT.

[By Edward Kemeys.]

umns near the entrance. Otherwise there is no sculpture to attract attention.

But, opposite the Manufactures building, toward the south, on the other side of the lagoon, is the important Horticulture building with sculpture by Lorado Taft of Chicago. Here, as on the Agriculture building, the decoration is suggested by the use of the structure. The sculptor writes: "The principal sculptural decoration of the building consists of two large groups, just outside the principal entrance. On the one side is the artist's idea of Autumn. The composition has been called the 'Sleep of the Flowers.' The sculptor endeavored to suggest here the quiet, al-

most melancholy, spirit of autumn, and with this object in view has kept all lines as harmonious and graceful as possible. The faces of the two sitting figures suggest sleep, and even the standing figure looks mournfully down upon them, as though she too would join them in their slumbers. The only touch of animation is the single belated cupid who sits contentedly absorbing a bunch of grapes. . . . On the other hand is the Springtime group, sometimes called the 'Battle of Flowers.' In this the artist has tried to express the vigor and push of awakening vegetation by means of broken and angular lines, making the composition as great a contrast as possible to the Autumn group. In this we have the figures of three nymphs, a faun, and two cupids, all laughing heartily as they pelt each other with buds and blossoms. The faun is engaged in binding a garland around the waist of the central figure, while she in turn has her arms full of flowers which she uses in her mimic warfare. The figures in these groups are about eight feet in height. . . . Just inside of the vestibule stand two figures, each ten feet in height. The one on the right is a light airy personification of 'Flora.' . . . On the opposite side is a figure of 'Pomona.' . . . On the eastern front of each pavilion at the ends of the building are two figures placed on the level of the second story. The one on the south is the 'Painting of the Lily.' . . . The next figure is symbolic of the cultivation and use of the grape, and represents a faun, a joyous, soulless creature, holding in one hand a brimming beaker, and in the other a bunch of grapes." The corresponding figures on the north are a woman representing "Botany," and a man representing a gardener examining the bursting buds of a vine. The building is further surrounded by a broad frieze of boys supporting garlands. The compositions are rich and full of pictorial interest, harmonious in lines and masses, and make the building one of the most interesting in the quiet richness of its ornamentation.

Lorado Taft was born in Illinois, studied at home, and later in the École des Beaux-Arts, Paris, as well as under Mercié. Among other works may be mentioned the Grant Statue at Fort Leavenworth. In addition to working in his own studio, he directs the classes in modeling in the Art Institute, Chicago.

The simple, but noble, Fine Arts building, in architectural proportions probably the most satisfactory in Jackson Park, has comparatively little sculptural decoration. There are, however, figures by Martiny representing Painting, Architecture, Sculpture, and

Music, and a Victory. Olin L. Warner has also contributed to its ornamentation relief portraits of great artists. Born in this country in 1844, Warner studied in the Beaux-Arts under Jouffroy, and later under Carpeaux. His "Shepherd Fountain" in Union Square, New York, and many of his portrait busts are familiar.

The Transportation building has sculpture by John J. Boyle, who was born in New York shortly after 1850, studied at the Franklin Institute, the Pennsylvania Academy of the Fine Arts, and in the École des Beaux-Arts, Paris. A group by him stands in Fairmount Park, Philadelphia. The subjects for the statuary upon the Transportation building relate entirely to transportation, and consist of realistic representations of great inventors in that direction, or of men engaged in that pursuit,—for example, "Brakesman," "Pilot," etc.

M. A. Waagen, a German sculptor, pupil of Kiss of Berlin, and later a resident in Paris, is mentioned in connection with statues on Machinery Hall, jointly with Robert Kraus, whose work is also upon this building.

The Danish sculptor, Carl Rohl-Smith, now living in Chicago, modeled the colossal statue of Franklin under the hemicycle portal of the Electricity building. The figure is colossal, and has the head thrown back and face upturned suggestive of his familiar experiments. The position of the statue is prominent, and it is well relieved against the shadowy background of the great portal. An illustration of this statue appeared in THE ENGINEERING MAGAZINE for March, 1892. The sculptor was born in Denmark in 1848, studied at the Royal Academy in Copenhagen, and later in Italy, France, Germany, and Austria. Among his works are a statue of "Ajax," a bronze statue of Judge Reid in Mt. Sterling, Ky., a marble statue of Colonel Montgomery in Memphis, Tenn., and a bronze statue of "The Hero of the Alamo," at Austin, Texas. He is at present engaged upon an important group for George M. Pullman commemorating the Fort Dearborn Massacre.

The Woman's building has also received its share of sculptural decoration, and from the hands of women. The main feature is the pediment by Miss Alice Rideout, of San Francisco, an allegorical embodiment of woman's work and power. The caryatids on the building are by Miss Enid Yandell of Louisville.

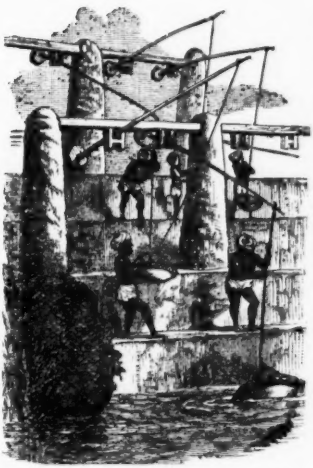
Of the other sculptures on the grounds we can stop to mention only the representations of American wild animals seen everywhere crowning the abutments of the bridges across the lagoons. These

are by the two Americans, Edward Kemeys and A. Phimester Proctor. Both are hunters, and students of the life of wild animals. Kemeys was born in Georgia, was a captain of artillery in the Civil War, then a farmer, and civil engineer in Central Park. His work is seen in Central Park, New York, in Fairmount Park, Philadelphia, and in other places. He is now engaged on two colossal lions for the approach to the new Art Institute, Chicago. A. Phimester Proctor was born in New York, and studied in the Academy of Design and in the Art Students' League.

It is hardly necessary to say that much other sculpture must remain unmentioned in an article of this length, the purpose of which is rather to call attention to the wealth of ornamentation of this character that has been employed in Jackson Park, and by pointing out its use, and its propriety there, to further the conviction that what has been here done for a temporary purpose ought to be followed in the permanent decoration of our towns and cities, their buildings as well as their public spaces. This coöperation of architects and sculptors is in itself an important lesson, for the building upon which sculpture is to be employed must in design be adapted to the sculpture which is to be placed upon it, quite as much as that sculpture must be in keeping with the architecture. Nor can these results be attained unless the builder be ready to allow to his architect and his sculptor sufficient latitude in the conception and treatment of the subject to secure a clear, consistent, and harmonious expression of their ideas of construction and ornament. Not that the purpose of the building shall in any way be sacrificed to secure artistic effect, for it is the first business of the architect to preserve the utility of the structure. The World's Fair has demonstrated an unexpected ability on the part of our architects to deal with plans of unlimited magnitude, and a totally undreamed-of capacity in our noble band of sculptors, of whom we may well be proud in the face of all the world.

THE DEVELOPMENT OF THE MODERN STEAM PUMPING-ENGINE—I.

By William M. Barr, M. Am. Soc. M. E.



PRIMITIVE METHOD OF RAISING WATER.

[From an old print.]

MACHINES for raising water may be said to be as old as civilization itself, and their invention extends so far beyond written history that no one can say when the art of lifting and distributing water began. Egypt, the land of unfathomable antiquity, the oldest civilization of the Orient, noted not only for her magnificence and power but for knowledge, wisdom, and engineering skill, understood and made practical use of such important hydraulic devices as the siphon and the syringe, the latter being a remarkable invention and the real parent of the modern pump. Whether or not syringes were ever fitted with inlet and outlet valves, thus making the single-action pump, is not known; but bellows consisting of a leather bag set in a frame and worked by the feet, the operator standing with one foot on each bag, expelling the inclosed air, the exhausted bag being then lifted by a string to refill it with air, implies the use of a valve opening inward, and it is difficult to conceive of a continuous operation without one.

A representative piece of mechanism occurs frequently on the sculptures of early Egypt. It has the appearance of, and is generally believed to be, that of a portable pump. The hydraulic screw is also attributed to this people, but their main reliance seems always to have been the *Shadóof*, seen everywhere along the banks of the Nile, an invention so simple and so well adapted to their needs that it remains to-day substantially the same as it has through all the centuries since history began.

The same may be said regarding the chain-pump in China, an invention the origin of which antedates the Christian era. This simple machine, which seems never to have been improved upon, is in such common use that every agricultural laborer is in possession of one. Where irrigation is conducted on a larger scale, the chain-pump is made proportionally larger and moved by a very simple tread wheel; and still larger ones are operated by yoking a buffalo or other animal to a suitable driving machine.

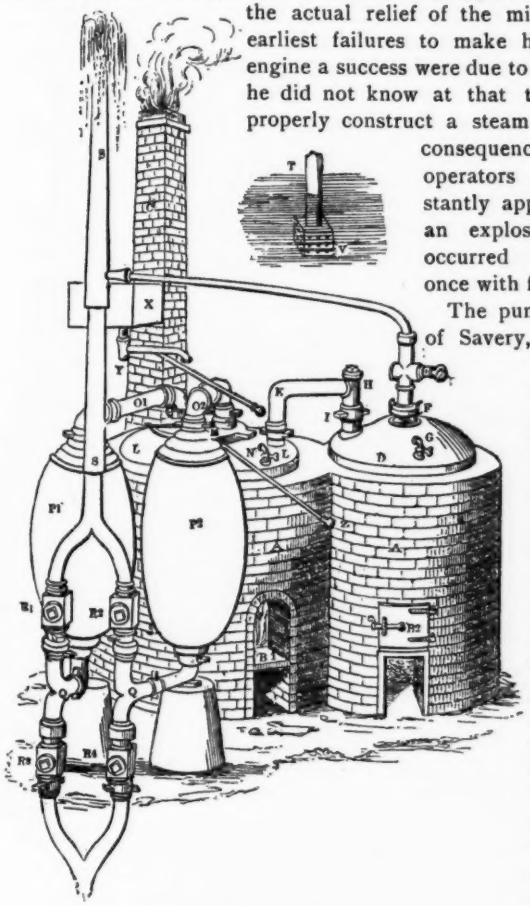
The application of steam to raising water is of uncertain origin. Long before the Christian era certain applications of fire to vessels containing water, by which effects were produced calculated to astonish ignorant worshippers, were practised by the priests of Egypt, Greece, and Rome; but their knowledge seems never to have been turned into any channels of secular usefulness.

Quitting the Orient, and confining ourselves to more recent times, the first application of steam power to raising water in England is included, but not specifically described, in an English patent granted to David Ramseye in 1630. Among the inventions claimed in this patent, one was "to raise water from low pitts by fire" and another "to raise water from low places and mynes, and coal pitts, by a new waie never yet in use."

About this time a number of inventive minds were struggling with the same problem. Among the more notable persons thus engaged may be mentioned Edward Somerset, the second Marquis of Worcester, who invented (some years later than the patent of Ramseye) a steam fountain, which is generally included in the earlier inventions in pumping machines. But Worcester's first device was simply a steam forcing machine and lacked the essential elements of a pump. About thirty years later, or say 1663, another machine was constructed by him, having two vessels which were alternately filled with steam; the steam condensing, the water rose by atmospheric pressure and filled the empty space, after which steam was admitted above the water, forcing it to a higher elevation. If only this operation had been automatic, instead of by hand, we should have in this early invention the parent of the modern pulsometer.

Thomas Savery, an English military engineer, patented a "fire-engine" in 1698, and in the year following exhibited before the Royal Society a drawing and model of his invention, which had many of the characteristics of the "water commanding" engine of the Marquis of Worcester. It is not known how much of Worces-

ter's invention was appropriated by Savery, if any, but the champions of the former scouted the idea that the latter had invented anything at all; however this may be, Savery applied his engine to the actual relief of the mines, and his earliest failures to make his pumping-engine a success were due to the fact that he did not know at that time how to properly construct a steam boiler. In consequence, the mine operators were constantly apprehensive of an explosion; which occurred more than once with fatal results.

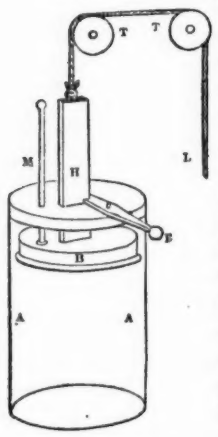


SAVERY'S FIRE ENGINE.

The pumping engine of Savery, like that of Worcester, had an independent boiler; but the latter was too weak at the joints for safe working at any but low pressures, say from one to two atmospheres, and three atmospheres was in point of fact above the safe limit of pressure. The boilers were of the crudest sort, being no more than large enclosed kettles, or drums, the heating surface being so small that a great waste of fuel followed as a matter of course. The application of steam directly

upon the surface of the water to be expelled from the pump chamber occasioned a serious loss of heat, because the sides of the chamber became heated to the temperature of the steam at each expulsion of the water; but with all its defects the modern steam pumping-engine may be said to have started with the invention of Savery's engine about the year 1700. How many of these "fire-engines" were erected we have no present means of verifying; there is reason to believe that a considerable number of them were employed for moderate lifts, but for deep mining operations they seem never to have been in favor.

The pumping-engine designed in 1690 by Denys Papin (about the same time as that of Savery) consisted of a boiler which also served as the engine cylinder, it being fitted with a movable piston. The bottom of this boiler was made of thin metal to quickly heat the contained water and convert it into steam. The elastic force of the steam so generated raised the piston to the top of the cylinder, a spring latch holding the piston in this elevated position in the cylinder, after which the fire was withdrawn and the steam condensed, forming a vacuum under the piston, which latter, being now unlatched, descended in the cylinder, and by means of a rope lifted the pump bucket. This invention, as a water-lifting device, was both crude and impracticable; and it bears no sort of comparison in point of usefulness with that of Savery. Aside from this impracticability, it marked one important step forward, and that was the employment of a piston in a steam cylinder; and to Papin, therefore, belongs the credit of this important invention.



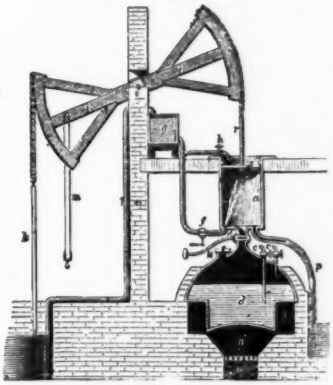
PAPIN'S ENGINE.

Thomas Newcomen some years afterwards (1710) designed an entirely new type of pumping-engine proposing "a steam cylinder containing a piston similar to that of Papin's, and to drive a separate pump." After the usual disappointments which seem to accompany all innovations on old methods, this invention gradually worked itself into favor by reason of the intrinsic merits of the machine itself; and the modern pumping-engine may be said to start from this point. The salient features of Newcomen's en-

gine were a separate boiler, a steam cylinder fitted with a movable piston, and the introduction of a water jet in the steam cylinder to hasten the condensation of steam.

We need not enter upon the question as to how much of the above was really original with Newcomen, but simply accept the fact that his was the first practicable scheme for operating pumping-engines by steam. It is true that this engine was not automatic in the necessary movements of the valve-gear; and it is also true that the application of the water jet within the steam cylinder is objectionable to the last degree from our point of view; but this does not detract from the merit of the original invention.

The above engine was greatly improved upon by John Smeaton, (1724–1792), a distinguished civil engineer who gave pumping-engines constructed under his direction better proportions, and secured for them better workmanship than had been employed previously. He also improved upon the steam boiler, and designed a better method of boiler setting, by which a large saving in coal was effected. Smeaton's success, considering the crudeness of even his best designs, as compared with later engines, was really remarkable; and too much praise cannot be accorded him therefor both as an engineer and a mechanic.

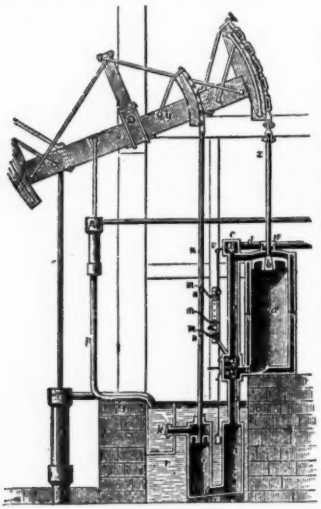


NEWCOMEN'S ENGINE.

To James Watt is due the credit of correcting the faults of the preceding inventions for pumping water by steam power. Watt was a maker of philosophical instruments in Glasgow. During the year 1763 a model of a Newcomen engine was sent him for repairs. Watt made a number of experiments with this model and found that it was extremely wasteful of steam; that as much steam was used at each stroke of the piston as would fill the cylinder three or four times, a loss occasioned by the alternate heating and cooling of the steam cylinder, and that a great advance in economy would be secured if the steam cylinder could be kept hot, and the condensation of the steam be accomplished in a separate vessel kept cold by the application of water or other cold bodies, this vessel

being in occasional communication with the steam cylinder, so that the steam could escape from the cylinder into it and be condensed at the right moment.

This invention of a separate condenser, which at this time was a surface condenser only, completely solved one difficulty, but introduced another which, for the moment, was quite as perplexing; and that was the accumulation of water of condensation within the condenser itself, which in a short time would fill it and render it inoperative; but Watt's genius was equal to this emergency, and thus resulted the invention of the air pump.



WATT'S ENGINE.

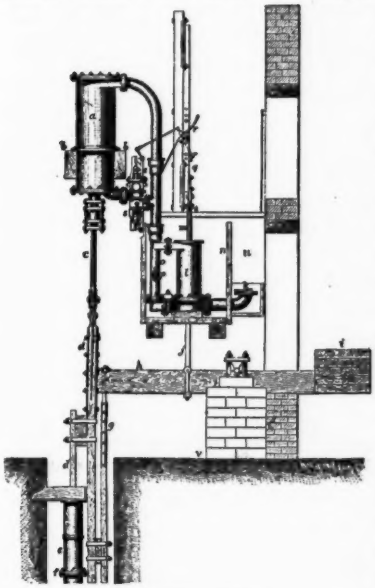
In order to keep the steam cylinder as hot as possible, Watt applied an outer cylinder, filling the intervening space with steam, so that the steam jacket was one of the results of this same investigation and experiment. The expansive property of steam now engaged his attention, the general facts regarding which were soon mastered by him, and an adaptation of the valve-gear to the new requirements enabled him to produce the expansion engine, with its consequent saving in fuel.

In 1773 Watt became associated with Matthew Boulton, and the afterwards famous partnership of Boulton & Watt was formed. Many details of the steam-engine portion of the pumping-engine were improved upon by this firm. In many instances it needed only better workmanship and proper machine-tools to bring that part of the machine to a reasonable degree of perfection. The engine was changed from single to double acting; and, to cheapen its construction, the independent jet condenser was applied to these engines instead of the more expensive surface condenser. This firm, before the year 1788 closed upon them, had produced in their establishment all the essential features of the modern steam-engine.

Previous to 1780 the energies of the preceding and other in-

ventors, such as Murdock and Hornblower, were almost wholly expended in the improvement of machines for "raising water by fire"; but the development of the rotative steam engine and the broader application of steam engineering generally were not only contemplated, but carried into effect. From this time forward a wide divergence in design occurs, and steam pumping-engines are relegated to a distinct class.

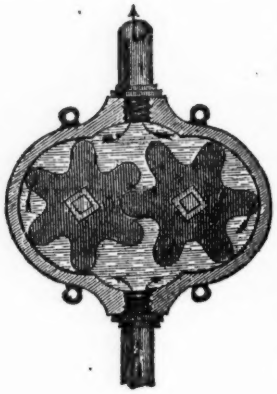
The steam-engine, in its first application, was designed for raising water; and, as it was a single-acting engine, the power was most conveniently applied indirectly through the medium of a vibrating beam. Among the contemporaries of Watt were William Bull and Richard Trevithick. Bull designed a vertical direct-acting pumping-engine, dispensing with the vibrating beam,—a design at once simple and direct. As showing the rapid advances made in the sizes of pumping-engine steam cylinders, it may be a surprise to some to know that, in 1798, an engine with a cylinder 60 inches in diameter, of this type, afterwards known as the Bull Cornish engine, was erected by the above engineers at the Herland Mine, Cornwall. This engine was adjudged an infringement on the patents of Watt, which for a time interfered with its introduction; but such engines were afterwards built in England and in this country. Direct-acting engines placed over the mouth of a mine are inconvenient and sometimes dangerous, and it is for this reason that beam engines are usually preferred; but apart from this the Bull engine was inferior to the regular Cornish engine in practical operation in the lack of sufficient time in transmitting the force of the steam, this occurring with too great suddenness upon the pump



BULL CORNISH ENGINE.

rods, an effect similar to that of a blow, which was both destructive and dangerous.

The Cornish engine does not differ essentially from the single-acting beam pumping-engine of Boulton and Watt. It has long been a favorite in England, especially for deep-mine pumping. It has also been employed in mining and water-works service in this country; but in most cases it has been superseded by other and later forms of pumping-engines. In the Cornish engine the steam pressure is exerted in lifting the pump rods, and usually a heavy weight, to the top of the pump-stroke; the steam pressure being then released, the pump-rods, assisted by the heavy weights attached to the beam, are allowed to descend by gravity, and in their descent the water is expelled at the mouth of the mine, or, if the mine be a deep one, from one level to another in the mine shaft, until the surface of the ground is reached. The Cornish engine is both expansive and condensing. The expansion is secured by the inertia of the pump rods, and, if necessary, by an extra weight added to the end of the beam. As the engine comes to a complete stand-still at the end of every stroke, more steam is required to begin the upward movement of the pump-rods and weight than is afterwards required to keep them in motion, and this energy absorbed at the beginning is given out at the latter end of the stroke, an effect similar to that of a fly-wheel, and which permits of a considerable degree of expansion. This type of pumping-engine is used in some of the deep silver mines in this country, and is said to possess advantages over every other kind of pumping-engine thus employed for excessive depths.



ROTARY PUMP.

The earliest pumping-engines, notwithstanding their crudeness, exhibited an economy favorable to their continued employment as compared with the cost of pumping by horse power. Smeaton made some tests to determine the actual work done by an engine after Savery's plan, and found that 5,250,000 foot-pounds per bushel of coal (84 pounds), or 62,500 foot-pounds of work per

pound of coal burnt, was the actual performance, which included that of the boiler also. The Cornish pumping-engines were a great advance upon what had gone before; the reports of the duty attained by some of these early engines do not appear to be as trustworthy as later publications. In 1776 Boulton and Watt guaranteed a duty of 22,000,000 foot-pounds per 112 pounds of coal burnt,—a performance which, at that time, they were not able to make good; but it is said that in a test of a 48-inch engine made some two years later a duty of 27,503,000 foot pounds was reached,—an exceptional performance considering the state of the art at that time.

In 1813 the reported duty of 24 Cornish engines, representing 998 horse-power, burning 3.4 pounds of coal per horse-power per hour, gave an average of 19,456,000 foot-pounds of work done for each 112 pounds of coal burnt in the furnaces; and by successive improvements the same number of Cornish engines (24) gave in 1856 an average duty of 47,000,000 foot-pounds. Neglecting the absurd claims made for certain Cornish engines, there are apparently trustworthy records in which more than 90,000,000 foot-pounds of work were had by an expenditure of 112 pounds of coal; but an average duty of say two-thirds of this is about all that can be safely relied upon for the best engines of this class.

THE WEAK POINTS IN TRADE-UNIONISM.

By Lawrence Irwell.

THE student of history who looks at the increasing numbers and improving organization of trade-unions will easily be convinced of the important part which they are likely to perform in the future of the United States; he will also be ready to admit that some form of united action is essential to the progress and amelioration of the wage-earning community. Indeed, the ability exhibited by what we are accustomed, very improperly, to designate the "working population"—as if brain-workers were not workingmen—in the formation and management of legitimate societies for their general welfare has already been displayed in so great a degree that it may be regarded as a proof of the capacity of the Anglo-Saxon race for all general purposes of self-government.

As the influence of unionism is daily becoming greater, it is more than ever necessary that its objects and attainments should be really liberal and that every step should be thoroughly considered before being taken. It is within the power of organized labor to do an immense amount of good or a serious amount of injury, not only to its own members, but to the country generally, and if it undertakes to effect any object outside its province, which cannot be achieved by the means at its disposal, even though the immediate results may appear satisfactory, yet eventually injuries of an extensive and widespread character are sure to ensue.

I propose to show that attempts upon the part of labor organizations to *permanently* regulate wages are, *in the majority of cases*, injurious to the best interests of the workers themselves and to the well-being of the community. Whether a man chooses to work eight hours a day or ten is a matter entirely under his own control; but whether his earnings shall be $3 or $5 a day is outside his influence, and beyond that of any combination of workers, because it depends upon circumstances which cannot be regulated by individuals, either alone or in a body. When attempts are made to secure higher wages than are produced by the natural process of supply and demand, with the addition of the skill of the worker, the outcome is in some instances utter failure, and in others a supposed success, which, when examined, shows that other workers

have been deprived of a portion of the reasonable earnings to which they were justly entitled.

The science of economics is not, I presume, a favorite study of trade-unionists, but all classes of the community have of recent years been willing to pay some attention to the doctrines which it propounds. A general increase in wages depends upon the augmented productiveness of the workers, either from increased skill or from improved processes or inventions; it may also be caused by an extension of markets, by the opening up of new countries, perhaps by the discovery of gold mines,—at any rate, by a new and greater demand for the products of labor, in return for which an increased supply of food and raw materials will reach the working community.

Having stated what all recognized economists admit to be the only causes of a *general* increase in wages, I must insist at the outset that the methods of trade-unions are not of such a character as will tend to produce the desired end. Indeed, their action is often directed towards decreasing rather than towards adding to the actual product of labor.

My general assertion is that, whenever unionism succeeds in keeping up a higher rate of wages than natural laws produce, the community of consumers pays the difference, and is therefore the sufferer by the process. To the unbiased observer this system will very closely resemble that of an import tariff, which assists one class—the manufacturers—at the expense of the rest of the population.

In every case in which labor below a certain rate of remuneration is prohibited by any device, the rate is kept above what it would otherwise be by a simple system of protection. Let us imagine a case in which the workers in some factory combine to secure higher pay than before and the manufacturer, through the pressure of contracts, or for other reasons, eventually consents. The increased wages do not come out of his profits, but out of the pockets of those who purchase his goods, because he will in the end recoup himself by raising the price of what he sells; whether he does so at once or not is quite immaterial. Eventually the purchasers are indirectly taxed for this addition to the earnings of the operatives in some one establishment.

The chief process by which general prosperity can be produced is by making the necessities of life as cheap as possible and by bringing various comforts within the reach of everybody; yet mem-

bers of trade-organizations frequently combine to raise their own wages and to make what they produce dearer to other workers. Could the laborers in all industries follow their example, all necessities would be dearer than they are, the cost of their production having been increased; this would mean a lessened demand, followed, of course, by a smaller output and a diminished employment of labor.

But it is not easy for all trades to combine; such work as requires special skill—say that of compositors—has far greater facilities for combination than a trade in which the manual operation is quickly learned. This fact is so obvious that it is needless to dwell upon it.

Wages are only worth what they can be exchanged for: how much their value is consists, not in the amount of gold or silver, but in the quantity of necessities that they will purchase. If, then, by a general system of unionism in every trade wages were increased,—say 5 per cent.,—an addition to prices would follow and no general advantage would be effected.

The struggles between capital and labor are not what they appear at first sight; they are conflicts between two sections of workers, and the second section, as I have shown above, very frequently constitutes the whole community of consumers. Unionists appear to think that men are producers only and that the higher prices are, the richer everybody will be. We are all consumers as well as producers, and, when cheap production is interfered with by artificial means, all of us suffer.

If there is one name which workers all over the world should honor more than that of perhaps any other man, it is the name of John Bright. In 1875 he wrote these words: "A book, not a small one, might be made up of the strange doings of trade-unions. Monopoly is hard to teach, and I fear the workingmen will only learn through suffering, and may do mischief which cannot be afterwards repaired." The unionists in the United States have learned neither by the experience in England nor by the words of Mr. Bright. Strikes for the purpose of obtaining higher wages have been numerous for some years past, and the actual loss to the country must have been enormous. So serious has the danger of a strike become that one great railroad is reported to be demanding that all those whom it employs shall either cease to be members of trade organizations or leave the company's service.

If unionists would realize the true basis upon which wages

stand, this element of danger would no longer exist. I repeat that I am aware of the contempt which organized labor professes to feel towards teachers of economic science ; nevertheless this must not deter me from stating the wages-fund theory as expressed very clearly by Professor Cairnes in his book, "Some Leading Principles of Political Economy." He says, "Wages-fund is a general term, used in the absence of any other more familiar, to express the aggregate of all wages at any given time in possession of the laboring population ; on the proportion of this fund to the number of the laboring population depends at any given time the average rate of wages : the amount of the fund is determined by the amount of the general wealth which is applied to the direct purchase of labor, whether with a view to productive or to unproductive employment."

The actual experience of Mr. (now Lord) Brassey in reference to the question of wages is most valuable, and I therefore reproduce his words : "High wages do not necessarily imply dear labor, just as, on the other hand, low wages do not, of necessity, make labor cheap. On my father's extensive contracts, carried on in almost every part of the civilized world and in every quarter of the globe, the daily wage of the laborer was fixed at widely different rates ; but it was found to be the almost invariable rule that the cost of labor was the same,—that for the same sum of money the same amount of work was everywhere performed. Superior skill, extra diligence, and a larger development of physical power will often compensate the employer who finds himself obliged to pay higher wages than his competitors."

Now what does this mean ? It means that wages are a question of supply and demand, depending upon the amount of work which the ability of the laborer will enable him to perform ; in addition, the demand must depend upon the prospect existing in the mind of the employer of finding a sale for whatever he may produce. As that is the primary consideration with any manufacturer in investing his capital, it must also govern his operations after he has actually commenced business. Should the demand for his goods increase, the amount of his investment will be augmented ; upon the other hand, let the demand be lessened, and, in order to escape loss, he will diminish the amount of capital invested. From these arguments the conclusion is necessarily deducted that, the larger the capital invested, the greater will be the amount of wealth spent in wages, assuming, of course, that other things are equal.

Unionists, however, appear to ignore the fact that by no possibility can capital be compelled to invest more money in wages after a minimum rate of profit has been reached, and they seem to forget that the competition of different capitalists in the same branch of industry is quite as keen as the competition among workers. The effect of this competition is to bring an excessive number of competitors into the profitable branches of industry, and thus to reduce the rate of profit. If then trade-unions insist upon attempting upon a large and systematic scale to force a redistribution of wages and profits, capital will most assuredly be withdrawn and will cease to be advantageously employed. I am not saying that temporary victories may not be gained in some branches of industry. Unions have undoubtedly succeeded in embarrassing many employers, who submitted to lose their entire profits for the time being rather than to close their works; but capital is abundant, and, if it were applied freely to every kind of employment with the effect of reducing profits to a minimum, the condition of the laborer would be vastly improved by the process. Work would be more plentiful than at present, and a greater degree of national prosperity would ensue.

Nothing that has been written vitiates the conclusion that an advance in wages in certain industries may be produced by the action of unions, where an equal reduction takes place in others; this reduction may not even appear in the money payment, but it is always evident in the purchasing power. Were it possible to exclude the work of outsiders,—sometimes of foreign countries,—the advance might be permanently maintained. Even this, however, amounts only to a change in the distribution of the "wage-fund," and its total amount remains the same.

In any form of employment of productive capital there can be no ultimate object beyond that of making a profit. Let this be obstructed, and the interests of the working classes will be injured as seriously as those of the capitalists. Yet the policy of trade-unions appears to be to impede the use of capital in profit-bearing enterprises.

There is, however, a marked distinction between productive and non-productive labor which must be observed in connection with the question of wages, although it would be difficult to specify exactly where the one begins and the other ends. In the case of productive labor the capital is returned with the addition of a profit, and the entire capital remains exactly as before. In the in-

stances of absolutely non-productive labor the capital is consumed and cannot, therefore, form any part of the future "wages-fund." But while we cannot draw any marked line between the two classes of labor, we know that capital expended in the employment of workers will in the majority of cases return to the capitalists plus a profit, and business will always be gradually extending.

Supposing, however, that the incessant pressure of trade-unions violates the general conditions previously referred to, and capital spent in the employment of labor is not restored with a profit, but with a loss, the members of the unions will feel the injury quite as soon as the employers and probably sooner. The use of capital in productive industries in which it is returned after a time with a profit will sustain the rate of wages, while that employed in the improper use of luxuries will give no return to the capital fund and will obviously have a harmful effect upon the earnings of the workers. In the former case employment will be constantly increasing, as the population grows,—a point which must never be overlooked in dealing with this somewhat complicated question.

I must express my firm conviction, with great reluctance, that it is against the reproductive use of capital that the action of the unionists is only too often directed; if the present state of affairs continues, capital is certain to be employed in forms unproductive as far as the "wages-fund" is concerned.

Feeling, as I do, that the leaders of strikes and members of unions generally will not hesitate to condemn all I have written upon this subject, I beg to make an extract from a speech delivered by the late Richard Cobden in 1849: "I wish to see the great mass of the working classes of this country [Great Britain] elevate themselves by increased temperance, frugality, and economy. I tell you, candidly, that no people were ever yet elevated except through their own advancing wealth, morality, and intelligence; and any one who tells the workingmen of this country that they may be raised in the social scale by any other process than that of reformation in themselves is interested either in flattering or deceiving them." If this applied to the wage-earners of the United Kingdom in 1849, does it not apply with equal force to those of the United States in 1893?

It should be distinctly understood that the foregoing pages have no claim to originality or novelty. Every fact has been written before,—perhaps many times,—but an attempt has in this

instance been made to put the whole of the subject concisely and clearly in the hope that some of the leaders of the wage earning classes may have an opportunity of learning that this question, like all others, has two sides to it.

Labor cannot benefit by fighting against capital, or by antagonizing investors. Unions are most useful institutions if they aim at such reforms as are required, and if they direct their exertions towards useful objects. The tyranny of which we hear so much is not by any means the tyranny of the capitalist, but of the improvident condition in which many of us live; and as soon as we possess any savings (*i. e.*, capital), the troubles of this condition are enormously lessened.

I venture to make two very simple suggestions, but, simple as they are, they are surely worthy of some very serious attention.

I. That trade-unions should offer every inducement to their members to save money, and thus become capitalists,—in a small way, perhaps, but still capitalists in the true sense of the term. When a strike takes place, the strikers often subsist upon the contributions of other workers,—a process which deprives many non striking wage-earners of the whole, or a portion, of their savings.

II. That full liberty be left to non-union workers to take the work of those who, by a system of combination, have "struck" for higher wages, and that no obstruction be placed in their way, or in that of the employer. In a few words, let the system of "boycotting" non-unionists, with the accompanying outrages, be a thing of the past. If there must be strikes, let them be as few as possible and let them be conducted in a creditable and orderly manner.

It is certain that workers can gain nothing by wasting their energy in denouncing the harshness of capitalists, while they are themselves throwing away the means by which they may become owners of capital.

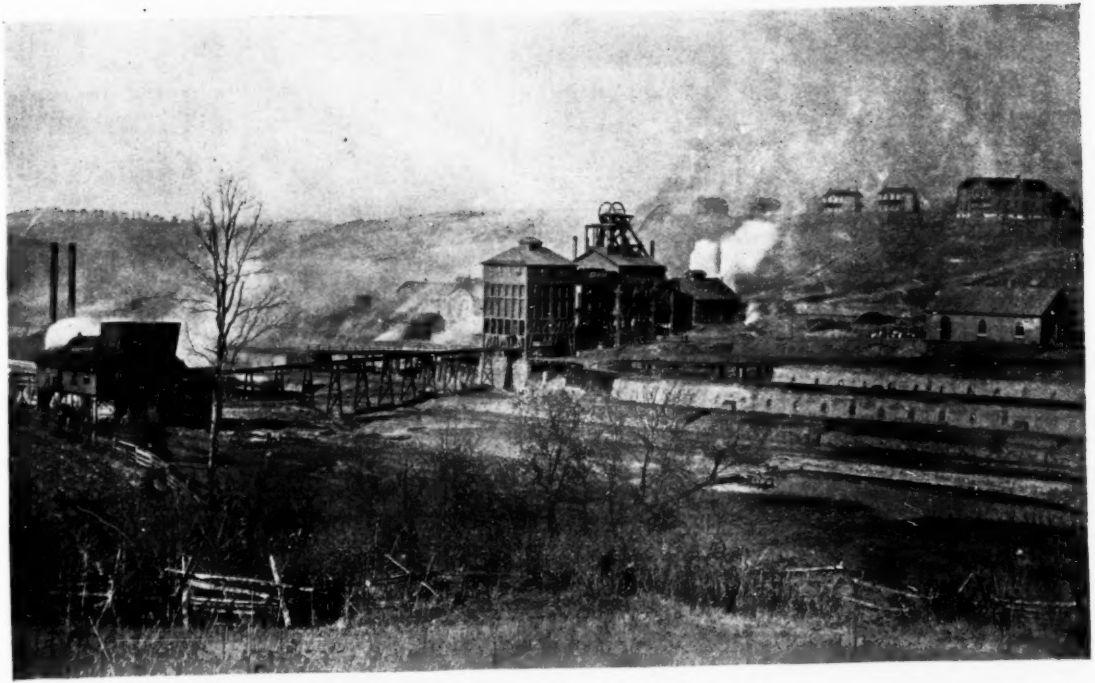
The wage-earners may be as intelligent, honorable, and contented as men of any other class, and indeed many of them are. The superiority of capital over labor has very frequently had its origin in abstinence, and in the denial of present benefit for future reward.

Some three centuries ago Montaigne wrote: "I have known in my time a hundred artisans and a hundred laborers wiser and more

happy than the rectors of the University, and whom I had much rather have resembled." Many of us to-day will re echo the sentiment, especially if millionaires be substituted for rectors of universities.

Capital is always ready to give employment to labor, and the wage-earners are always willing to be employed, yet the continual strikes are causing the one class to regard the other as enemies, instead of brother-workers. Surely the more intelligent unionists must be beginning to see that the heavy losses are impoverishing the very men who cause the strikes, and are subjecting the productive industries of the country to a strain of an almost intolerable character.

Let us sincerely hope that the day is approaching when reasonable demands will be conceded without strikes, and when deliberation, coupled with a free interchange of opinions, will promote confidence and mutual regard in place of animosity and distrust.



LEISENRING NO. 3 WORKS—THE H. C. FRICK COKE COMPANY.

COKE MANUFACTURE IN THE UNITED STATES.

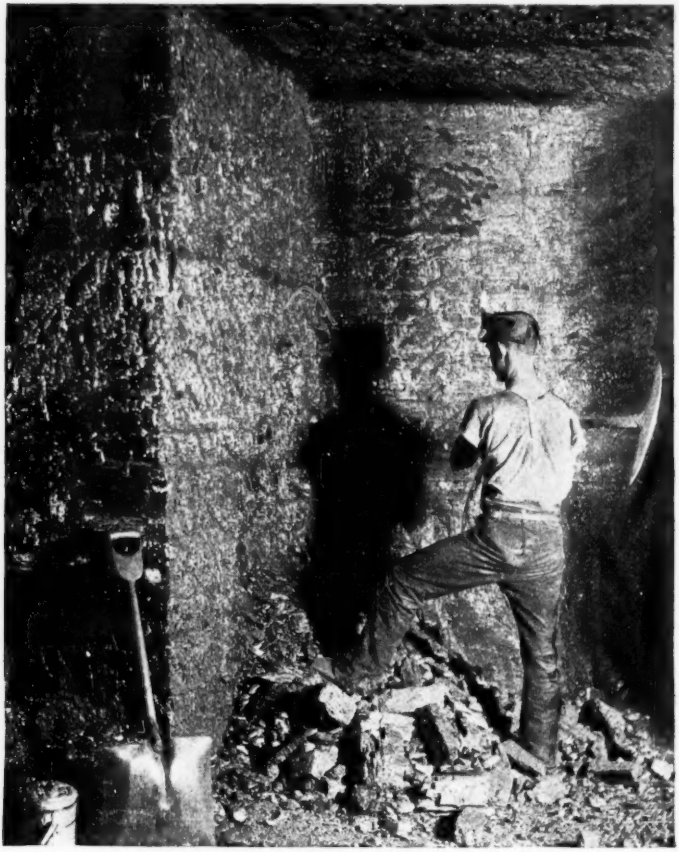
By William Glyde Wilkins, M. Am. Soc. M. E.

THE output of pig-iron from the blast-furnaces in the United States has increased to a surprising extent since 1880. While the influence of improved forms of furnaces, hot-blast stoves, and blowing engines is to be considered, it is undoubtedly true that a very large share of the increase is due to the substitution of coke for coal as fuel. In 1875 Mr. John Fulton, in a report of the Pennsylvania State geological survey, wrote: "It is also manifest that *coke is destined to become the leading fuel for blast-furnaces, and to retain this position from its almost inexhaustible source of supply, its calorific intensity, and its continued economy.*" The italics are Mr. Fulton's. The results in present blast-furnace practice have more than justified his prophecy. Previous to the year last named the amount of anthracite coal used to produce one ton of pig-iron was 1.85 tons. Now, in the Pittsburgh district, where there are twenty-three blast-furnaces, the yield of pig-iron is one ton to one ton of coke, while furnace "F," at the Edgar Thomson steel-works, has used as low as 1845 pounds of coke to produce one ton of iron. Stimulated by the demands of the furnace men, the manufacture of coke in the United States has increased to a very large extent. In 1891 the coke industry was in progress in no less than twenty States, requiring 40,245 ovens. The output of coke for that year, according to the special report prepared by Mr. Joseph D. Weeks for the United States census, was 10,352,688 tons.

The manufacture of coke on a large scale in the United States was first started in the Connellsville region, in Pennsylvania, and a reference to the report by Mr. Weeks will show that this State still holds the lead in the number of ovens and extent of output. It is conceded by blast-furnace operators that the Connellsville product gives better results than any other coke made in the United States, and it is shipped to all parts of the country to which freight rates are not so high as to prohibit its use. The Connellsville practice has become the standard both for method of construction of plants and manner of operation, and hardly a day passes that persons interested in the manufacture of coke in other

parts of the Union do not visit this region for purposes of investigation. The writer believes therefore that a description of methods in this region will give what may be considered to be the standard practice in the United States.

The Connellsville coke region is situated in Fayette and Westmoreland counties, Pennsylvania. According to a recent topographical survey made by Kenneth Allen, M. Am. Soc. C. E., for the H. C. Frick Coke Company, the basin has a length of 43.6



COAL-MINER AT WORK.

PLANT NO. 2—HECLA COKE COMPANY, LIMITED.

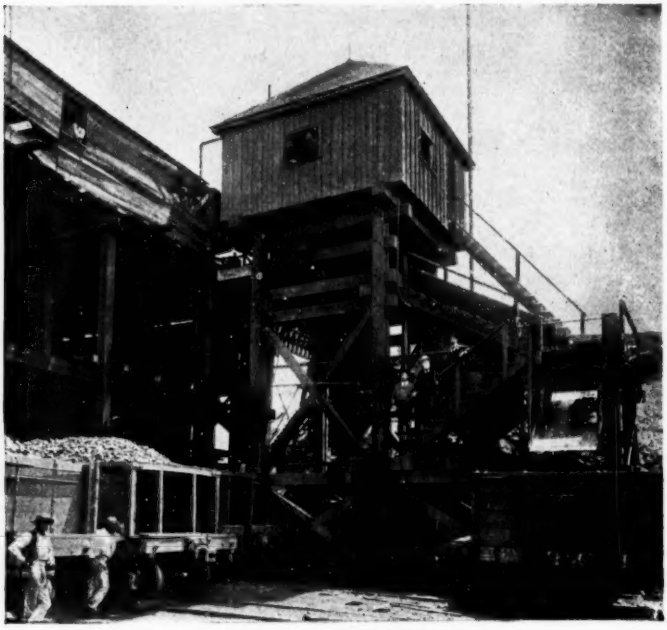
miles, and an average width of 3.1 miles, or an area of 137 square miles. The region takes its name from the town of Connellsville, in the center of the basin, near which the manufacture of coke was begun. A history of the region would be practically a history of the H. C. Frick Coke Company, who own and control 9096 of the 17,315 ovens in the basin, or considerably more than half the entire number. The McClure Coke Company rank second, having 2905 ovens, and W. J. Rainey third, with 1400. There are eighty-four mines and coke plants in the district, the plants ranging in size from 39 to 905 ovens, the later being the Standard plant near Mount Pleasant.

A recent writer in the Connellsville *Courier* says: "The first coke made in this region was made in 1841, by McCormick, Campbell, and Taylor, in two ovens, built near the mouth of Hickman run. These two ovens were built from a description given them by an Englishman of the ovens in Durham, England. The makers had hard work to dispose of their product at eight cents per bushel, and retired from the business in disgust. However, James Cochran and others saw an opportunity in the business, and leased

the plant, and in 1842 they sold in Cincinnati 13,000 bushels at seven cents. James Cochran continued in the business, and is to-day part owner in three plants, of 750 ovens." From this small beginning has grown a business that in 1891 amounted to an output of nearly 5,000,000 tons, or nearly one-half the product of the United States, giving direct employment to about 18,000 men. The increase in the number of ovens, since 1860, is thus shown:

1860	30 ovens.	1887	12,561 ovens.
1872	3,673 ovens.	1888	13,113 ovens.
1880	6,237 ovens.	1889	14,458 ovens.
1882	8,400 ovens.	1890	16,020 ovens.
1884	10,000 ovens.	1891	17,204 ovens.
1886	10,854 ovens.	1892	17,315 ovens.

Geologically speaking, the coal belongs to the Pittsburgh vein, but it is not connected directly with that vein in the neighborhood of Pittsburgh. It is much softer than the coal mined about Pittsburgh, and in mining breaks up quite small, and the run of mine



COAL-WASHER, SLOPE NO. 2, PRATT MINES.

VENTILATING FAN AT FRICK'S ADELAIDE WORKS.

coal has a very large percentage of slack. In the Connellsville region the entire output of the mines is coked. On account of its fineness it does not need crushing, and its purity makes washing unnecessary. For these reasons it is cheaper to coke than other coals which are harder and less pure, and which have to be both crushed and washed. The great point in its favor above all other cokes, and which is recognized by iron-manufacturers, is its hardness or ability to sustain the burden of the ore and limestone in the blast-furnace. Below is given a table showing a comparison of analyses of the Connellsville and other cokes:

ANALYSES OF COKE.

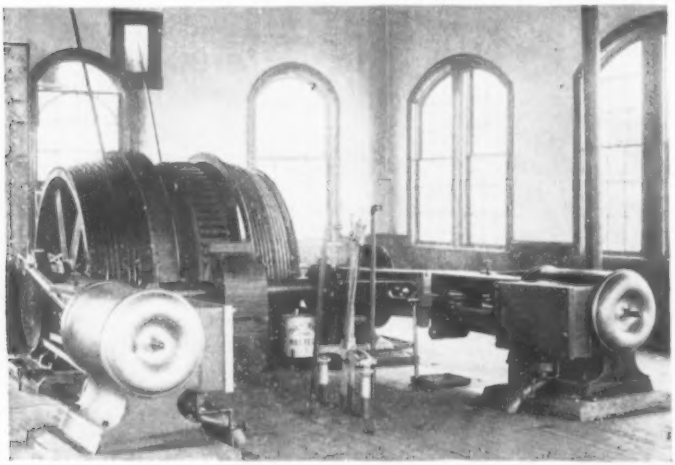
[From report of John R. Procter, Kentucky Geological Survey.]

Where Made.	Fixed Carbon.	Ash.	Sulphur.
Connellsville, Pa. (Average of 3 samples).....	88.96	9.74	0.810
Chattanooga, Tenn. (Average of 4 samples).....	80.51	16.34	1.595
Birmingham, Ala. (Average of 4 samples).....	87.29	10.54	1.195
Pocahontas, W. Va. (Average of 3 samples).....	92.53	5.74	0.597
New River, W. Va. (Average of 8 samples).... .	92.38	7.21	0.562
Big Stone Gap, Ky. (Average of 7 samples).... ...	93.23	5.19	0.749

Twenty-one of the eighty-four mines have shafts, ranging from 50 feet deep, at the Adelaide works, to 541 feet, at the Leisenring

No. 3 works. The others are slope or drift mines. There has been much discussion as to the comparative advantages of shafts and drift or slope mines. The majority of engineers and operators in the Connellsville region seem to favor the shaft. However, in opening up the mines this discussion does not appear to have been a factor, as local considerations have almost entirely determined the method in each case. In starting a new plant, proximity to some railway has generally influenced the location of the surface works. It is the general opinion, however, that in shaft mines the coal is in the long run mined more cheaply than in drift or slope mines.

The vein of coal is from seven to nine feet thick,—averaging



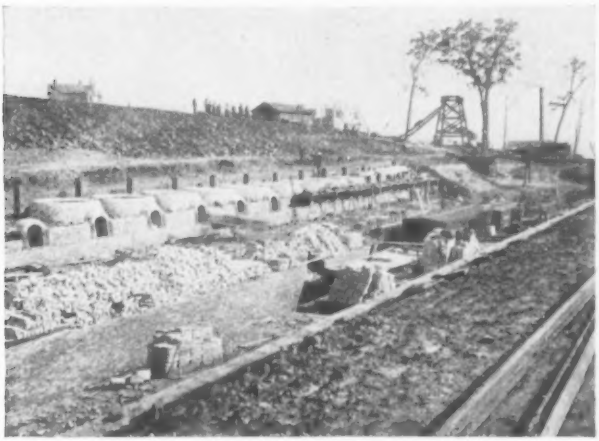
HOISTING ENGINE IN A COKE-PLANT.

about eight feet,—and will yield about 8000 tons of coal to the acre. A reference to the columnar section of Leisenring No. 3, the deepest shaft in the region, will show the strata and coal veins. The nine-foot vein is the only one mined, except at one or two mines, where slopes or drifts have been driven into the five-foot vein.

The usual method of mining is the pillar and room system, with from one to five-main entries. At the Oliver mines, near Uniontown, the coal is being taken out on the five-main entry system, this being the only mine in the country where this is done. Some advantages claimed are: ventilation without the use of

PLANT NO. 1—OLIVER COKE AND FURNACE COMPANY.
[First steel head frame designed in the Connellsville region.]

doors; separate intakes and outtakes for each district; a great reduction in number of stoppings; the passing of intake air-currents to extreme end of main headings, without passing old workings; the division of the air-current so as to more easily and safely regulate the velocity; all return air-currents may be through disused headings, and the hauling roads and traveling ways may be intakes.



COKE-PLANT IN COURSE OF CONSTRUCTION.

In slope and drift mines the pit cars are hauled up an incline to the top of the coal-bin, from which the larry wagons are loaded. In shaft mines the pit-cars are in most works pushed from the cage by hand at the upper landing and dumped into the bin by hand. At some mines this is done by "Ramsey's patent caging apparatus," which pushes the loaded car off the cage, and an empty car on, at one operation. After the coal is dumped, the car runs by gravity to the back of the cage and is then ready to push the next load off. At other mines the self-dumping cage is used. With this method the car does not leave the cage, but the coal is dumped

COKE OVEN PLANT.
[Showing double block complete; bank ovens partially built.]

automatically to the bin with a saving of the labor of one to three men.

The coal is taken from the bottom of the bins into the larry wagons, and from these dumped into the coke-ovens. Mules are still used to move the larry wagons at the smaller plants, but small locomotives, weighing about 6½ tons, are more generally used, hauling four larries at a trip. At some of the works a wire-rope haulage, extending from under the bin to the lower end of the ovens, is used to draw the larries. Wire-rope haulages are also largely used

in the mines in the main headings. The cars are hauled by mules from the rooms to the main headings, where "trips" of as many as twenty cars are hauled to the tipple or to the bottom of the shaft.

The Connellsville ovens are of what is known as the "Bee-hive" type, and are from 10½ to 12½ feet in diameter, and from 6 to 8 feet high. The charge for each oven is from 110 to 190 bushels of coal, and the yield of coke per oven drawn is from 3 to 4¼ tons of coke. The majority of the product is 48-hour coke, this being the length of time for the coking process before the charge is drawn. The Friday and Saturday charge, however, is not drawn until Mon-

NO. 2 OVENS, PRATT MINES, ALABAMA.

day, making what is called 72-hour coke. This is known as foundry coke, and is preferred in foundry work.

Crushed coke is now being introduced into the eastern part of the United States in competition with anthracite coal for domestic use. There are much less gas and bad odors from it than from the hard coal. It is also being used in locomotives on the fast passenger trains of the Baltimore and Ohio railroad between New York and Washington. It will probably be used very largely in the future in Pittsburgh, now that natural gas is becoming scarce as its freedom from dirt and small amount of ash, as compared with the bituminous coal formerly used before the days of natural gas, make it preferable.

DRAWING COKE FROM OVENS.

When the coal is first dumped into the oven, it is levelled down to a uniform thickness, and the door is bricked up and daubed with loam, leaving no opening, except about two inches at the top, the full width of the door. The heat in the bricks of the oven, after the preceding charge, soon ignites the gases at the top, and the draft is regulated by bricking up or taking out bricks, so as to properly coke the coal without consuming it. After the proper time has elapsed, the coke in the oven is cooled off by drenching it with water. The coke is then drawn out of the oven to the yard in front and further watered, so as to cool it sufficiently to prevent setting on fire the railway cars in which it is loaded. The coke is wheeled into the cars, which contain from 30,000 to 50,000 pounds each. The Frick coke company are now experimenting with a mechanical coke-drawer which, it is said, will draw forty ovens per day and with one man will do what is now done by fifteen men.

The amount of water required to cool one oven of coke is 600 gallons, so that, when all the ovens in the region are in blast, one-half being drawn each day, there is a daily consumption of water for this purpose alone of about 5,200,000 gallons. This amount of water would supply a town of 52,000 inhabitants with 100 gallons daily, per capita. Taking into account the uses for boilers, domestic supply, etc., it is probable that double this amount is used. Most of the works get their water-supply from small mountain streams, which in summer time are very scanty, and it is often

absolutely necessary to use mine water for washing the coke. This water is very strongly impregnated with sulphur, more or less of which is of course imparted to the coke. It will thus be seen that the question of a pure water supply is a very serious one for the region. In order to be certain of an unfailing supply the Oliver coke works obtain their water from the Youghiogheny river, at a distance of eleven miles. The water is pumped through eight-inch pipe that formerly supplied Uniontown with natural gas, this being the first instance of a natural-gas line being transformed into a water line.

The buildings, head frame, etc., about the shaft were formerly built of wood and in the cheapest manner possible. The numerous losses by fire have impressed on the larger operators the necessity for better construction, and brick or iron buildings, and iron and steel head-frames, are now built. It is probable that in all future plants iron and steel will be the material used.

In building a coke-plant experience has shown that for every coke oven the company should have about thirty acres of coal. Besides the ovens, the plant will have to be provided with the proper hoisting engines, boilers, buildings for same, locomotives, tools, etc. Most plants have also a number of dwellings, which are rented to the workmen at reasonable rates, as it is better to have the men live near the works. The houses for miners and coke-workers are generally double houses, having in each half four rooms, well plastered and substantially built. Each tenant has a

TENEMENT-HOUSES AT TROTTER WORKS (FRICK COMPANY).

lot 50 by 100 feet, and many of them transform this ground into vegetable- and flower-gardens.

As to the cost of building a coke plant, the writer can say from his experience as a constructing engineer that a 300-oven plant, substantially built, with the necessary machinery, buildings, railway tracks, and houses for the miners, exclusive of the shaft or slope, can be erected for $200,000, or say $700 per oven. If a shaft is sunk, there should be added to this $100 for each foot of shaft, to 300 feet deep, and $125 for each additional foot. The cost per oven, including grading, masonry, oven brick, and railroad tracks, or all items chargeable to oven construction, is about $325 per oven. These figures are exclusive of cost of coal-lands.

The laborers in the Connellsville region are mostly immigrants of the most degraded and ignorant classes, the Hungarians predominating. They were first brought into the region to take the place of strikers, but it did not take them long to get sufficiently Americanized to begin striking on their own account. In 1891 the scale under which they were working expired, and 16,000 workers went out on a demand for an advance in wages amounting to about 12½ per cent. Their demand was not granted, and the refusal was the excuse for outrages of the most violent character. Works were set on fire, buildings wrecked, men who wanted to work were mobbed, and the entire region was in a state of uproar. The sheriffs not being able to maintain order, the governor called out the State troops, and in a conflict between the strikers and troops at the Moorewood works a number of persons were killed. After fourteen weeks of idleness the strikers returned to work at prices dictated by the employers, and there has been no further outbreak.

The Connellsville region has been the scene of many accidents and great loss of life. On June 6, 1890, a fire broke out in the Hill Farm mine, causing the death of thirty-one miners and entailing great loss on the mine-owners. A bore hole had been put down from the surface, and, when this hole was opened in the mine, a large amount of water rushed in. The noise of the rushing water alarmed a miner, and he ran frightened along a heading with a naked light. As he passed the bore hole his lamp ignited a gas-feeder. In a few moments the whole slope was on fire, and it was twenty-two months before the water was pumped out and the last of the bodies recovered.

Six months later an explosion occurred at the Mammoth mine,

which was the most disastrous accident, counting the loss of life, that ever occurred in Pennsylvania. It occurred from an explosion of gas intensified by fine coal dust, and fully 75 per cent. of the 109 men killed were smothered by after-damp.

Since these accidents it has become almost the universal custom not to allow the miners to use naked lights, and all are furnished by the mine-owners with safety-lamps. Quite a number of mines now light the shaft bottom, pump room, and stables with incandescent electric lights. As a rule the owners of the mines do all in their power to prevent accidents, as a matter of good business policy, as well as from motives of humanity. There are, however, some owners too parsimonious to take precautions that they are not forced by law to do. There is now before the State legislature a proposed new mine law for the bituminous regions, the purpose of which is to compel mine-owners to take all precautions possible for the protection, not only of life, but of their own property as well.

In Fayette and Westmoreland counties there are quite a number of plants outside of the Connellsville district making coke from the Pittsburgh vein. Coke is also manufactured to some extent in fourteen other counties in Pennsylvania.

No attempt is made to save any of the by-products, such as tar and ammonia. Some experiments have been made in this country with different forms of patent ovens, but they have so far proved unsatisfactory. One great objection to any of these forms is their great cost as compared with the "bee-hive." It has always been a question with coke manufacturers whether the revenues derived from the by-products would give a sufficient return for this increased investment. The fact that there have been no plants built in this country for the purpose of saving these by-products shows that the owners thus far have answered this question in the negative.

Alabama ranks next to Pennsylvania in the production of coke, the yield in 1891 being 12.39 per cent. of the entire output of the United States. In 1880 this State stood sixth in the list, producing only 1.53 per cent. of the total for this country. This great advance has been in connection with the great development in the iron industry in the neighborhood of Birmingham. The yield in 1891 was 1,282,496 tons, from 5068 ovens. Of this number 4431 ovens are in the Warrior District, 567 in the Cahaba, and 70 in the Coosa district.

The coal-fields of Alabama aggregate nearly 8700 square miles, of which 7810 are drained by the Warrior river and tributaries and by the Tennessee river, and are called the Warrior district. It comprises all that field northwest of the Alabama Great Southern railroad. The next largest district, southeast of the Warrior, is drained by the Cahaba river, and contains 435 square miles. The Coosa district, containing 415 square miles, is drained by the river of the same name. Mr. Henry McCalley, the assistant State Geologist, says that the Warrior field alone contains three times as much coal as the bituminous and semi-bituminous fields of Pennsylvania.

The largest coke-producers in Alabama are the Tennessee Coal and Iron Company, whose various plants include the following ovens :

	Ovens.
Pratt Mines Division—Plants No. 1, No. 2, No. 3, and No. 4, (Six miles from Birmingham)	808
Cahaba Division—Blocton	467
De Bardeleben Division—Bessemer, Blue Creek, and Helena	1,120
Birmingham Division—Alice furnace	250
Total ovens of this Company in Alabama	2,645

The coke is made from coal mined in the Pratt seam, and the analysis is about the same as Connellsville coke, with the exception of the ash and sulphur, which are somewhat higher.* About one-third of the coal coked at Pratt mines plants No. 3 and No. 4 is crushed and washed in a "Robinson" washer, as is also the case at No. 2. Both washers have proved satisfactory, and the coke is improved in quality, and Mr. Erskine Ramsey, M. E., of this company, is of the opinion that it will not be long before all coke made in this State will be from washed coal. At plant No. 2 the waste heat from a battery of twenty-five ovens is used to run two batteries of boilers, which furnish the steam to operate the machinery at shaft No. 1. This has proved so satisfactory that another boiler-plant to be operated in the same manner is now being erected.

This company also own five plants in Tennessee, having 638 ovens. The total number of ovens operated by them is 3283, making them rank second as coke-operators in the United States.

The manufacture of coke in West Virginia was first begun in the Kanawha district in 1878. There are now in that district 474 ovens. There are in New River 787 ovens, in Flat Top 1889, in

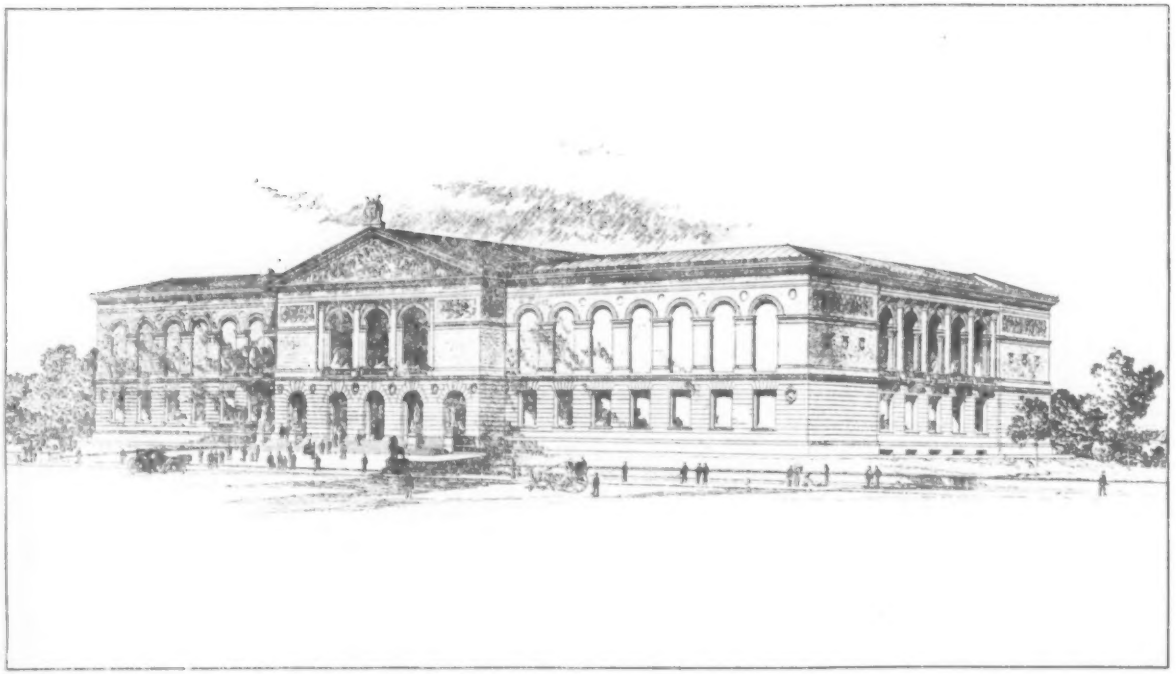
* A more complete account of Alabama coal and coke may be found in the Transactions of the American Institute of Mining Engineers, Vols. XVII and XIX.

the Northern district 1081, and in the Upper Potomac 390 ovens. The Flat Top field, in which the first ovens were built in 1886, is considered by many to be the most promising in the country, next to the Connellsville region. It has been made the subject of an interesting special report for the eleventh United States census by Mr. Joseph D. Weeks.

The coal-lands in this field are owned or controlled by either the Flat Top Coal Land Association or the Crozier Land Company. The coal is mined on a royalty, and all lessees are required to sell their output through the Pocahontas Coal Company. The coke is sold through the Hull Coal and Coke Company. In this field only slack is coked. The yield of coke is generally put at 62½ per cent., but operators admit that it runs as low as 53 per cent. Over half the coal coked in this State is washed before coking.

Tennessee ranks fourth as a coke-producing State, the output in 1891 being 3 52 per cent. of the entire amount. The coal-fields are an extension of the bituminous fields of western Pennsylvania and West Virginia, covering an area of more than 5000 square miles. The seams from which coke is made are from three to five feet in thickness, and generally variable. Most of the coke is made near and used in the blast-furnaces of the Chattanooga district, and contains from 16 to 23 per cent. of ash. It is also higher in sulphur than the Connellsville coke. The amount of coke used in the blast-furnaces in this district is about two tons to one ton of iron, but, as the coal is plenty and cheap and cost of transportation small, iron-manufacturers are satisfied to use this quality of coke rather than pay a higher price for a better grade.

While Tennessee is fourth in rank, it produced in 1891 but 364,318 tons, as against 4,760,665 tons in the Connellsville region. None of the other sixteen States produced over 40,000 tons, except Virginia, Georgia, and Colorado.



THE ART INSTITUTE OF CHICAGO.

[The International Engineering Congress will be held in this building.]

THE WORLD'S FAIR INTERNATIONAL ENGINEERING CONGRESS.

By J. K. Freitag.

"It is the glory of Engineering in its supreme purpose to apply the materials and forces of nature to the service of man, and make him master of land and sea."

TO the Western Society of Engineers belongs the credit of having inaugurated, in connection with the World's Columbian Exposition, a movement of the greatest importance to the science of Engineering,—a movement contemporaneous with activity in every branch of thought, which has resulted in a series of international congresses, already so successfully begun by the Woman's Congress and followed by others up to the present date. These congresses will be in session during the entire six months of the Exposition, and will deal with every subject pertaining to the intellectual, moral, and spiritual advancement of man.

The World's Congress Auxiliary, with Charles C. Bonney as president, is an organization authorized by the directory of the Exposition, and recognized and approved by the United States Congress, to have charge of and conduct all conventions relating to human progress, with the assistance and coöperation of the leaders in every branch of thought. Thus while the Exposition proper deals with things, or the *material* presentation of human achievement, the Congress Auxiliary endeavors to portray intellect, the scientific and moral principles underlying material accomplishments, or, as the motto of the Auxiliary defines it, "Not things, but men." It is the first time in the history of the world that one organization has attempted to bring into the connected and harmonious relations of a whole all the distinct branches of human progress.

The results of these congresses will be the expounding of the best principles and methods of promoting the advancement, welfare, and happiness of the human race, and the effectual accomplishment of these methods by the formation of international brotherhoods whose efforts will keep the whole world abreast the onward strides of thought and civilization. There will be nineteen

departments in this congressional work, convening in the following order:

May. I. Woman's Progress.
II. The Public Press.
III. Medicine and Surgery.
June. IV. Temperance.
V. Moral and Social Reform.
VI. Commerce and Finance.
July. VII. Music.
VIII. Literature.
IX. Education.
Aug. X. Engineering.
XI. Art and Architecture.
XII. Government, Law Reform, Political Science.
XIII. General Department.
XIV. Science and Philosophy.
Sept. XV. Labor.
XVI. Religion, Missions, and Church Societies.
Oct. XVII. Sunday Rest.
XVIII. Public Health.
XIX. Agriculture.

When the idea of a series of world's congresses was first advanced, the president of the World's Columbian Exposition appointed a preliminary committee to investigate the scope of such congresses. It soon became apparent that the extent of such an undertaking was far beyond the reach of a single committee, and that an auxiliary organization must be formed. Therefore the World's Congress Auxiliary of the World's Columbian Exposition was organized on October 30, 1890, and full authority given to it to execute arrangements for the world's congresses of 1893. It was decided that the affairs of each congress were to be conducted by a committee, the members of which were to be chosen from Chicago and its vicinity, in order that they might be able conveniently to carry on all the local arrangements for the congress. These committees have had charge of correspondence to interest kindred associations in the work of the various departments. They are assisted by an advisory council composed of non-residents in the United States and foreign countries who assist the local committee as freely as possible by individual correspondence, and aid in the selection of topics and of persons eminent in the various branches of the congressional work. An honorary membership has also been formed, as a general advisory council in the congressional work at large. In order to procure the most comprehensive and

effectual results, the various existing societies and institutions were requested to appoint committees of coöperation to assist the Auxiliary proper in arranging for their own special departments.

The importance of the World's Congress was recognized by the government of the United States, which took active measures to gain the interest and coöperation of foreign countries in this work, as well as in the material exposition. The original announcement of the World's Congress Auxiliary was sent to all countries of the world accompanied by the invitation of the president of the United States to take part in the Exposition of 1893; and to all the diplomatic and consular officers of the United States was sent a circular asking them to invite the respective governments to which they were accredited to send a convenient number of the most eminent representatives of the various departments of human progress, as delegates to attend the congresses, in addition to those who would come from abroad as representatives of leading institutions and societies. It was requested that these delegates be permitted to attend all the congresses held from May to October, in order that, by the coöperation of every existing government, there might be ascertained the state of human progress in every department up to the year 1893; that the living problems which remain unsolved might be clearly set forth, and the methods of their solution be arbitrated upon, thus promoting fraternal relations and the highest mutual benefits. In reply to the invitations of the government, the most encouraging and interested responses were received from all parts of the world, and now the one original committee has ramified into more than 200 committees, of which the aggregate membership is over 1600 persons. The honorary and advisory members are more than 10,000 persons from the various countries represented.

The proceedings of these congresses in all probability will be printed by the United States government for distribution among foreign governments and their institutions and libraries, as a lasting return for their part in the World's Columbian Exposition.

The congresses are now being held in the permanent Memorial Art Palace, which has just been completed on the Lake Front Park in Chicago at an expense of $800,000, through the joint efforts of the Art Institute of Chicago, the City of Chicago, and the directory of the Exposition. The Art Palace has two large audience-halls seating some 3000 persons each, and more than thirty smaller rooms

seating from 300 to 700 persons each. The main halls are being used for meetings that attract large popular audiences, while the discussions of special subjects go on at the same time in the smaller rooms.

At the time when the question of the site for a World's Exposition in 1893 was first being agitated, a committee of civil and mechanical engineers, with Mr. E. L. Corthell, past president of the Western Society of Engineers, as chairman, was appointed to further the interests of Chicago as a suitable place for such a fair. At the same time the idea was presented by Mr. Corthell of making this an opportunity for holding an international congress of engineers. A circular to this effect was, therefore, sent out as early as October 7, 1889, to all of our national and local societies. Encouraging answers were received in regard to both projects. At a special meeting of the Western Society of Engineers, in the spring of 1890, after the Exposition had been authorized by the United States Congress on April 25, it was decided to take the initiative steps for such a gathering of engineers. The American Societies of Civil, Mechanical, Mining, and Electrical Engineers, and the Canadian Society of Civil Engineers, were each requested to appoint a committee of not more than five members, two of whom were to be residents of Chicago; these delegates to meet at a convention in the fall of 1890, with a committee composed of seven members of the Western Society of Engineers, to formulate the plans of the congress. All local societies of the United States and Canada were requested to send committees of three to this convention. At the meeting of this convention on October 14–15, 1890, headquarters were established, and a permanent committee was agreed upon composed of three members of the Western Society of Engineers, two members each from the American Societies of Civil, Mechanical, Mining, and Electrical Engineers and the Canadian Society of Civil Engineers, and one member each from the other participating societies. This general committee met in May, 1891, and was addressed by Mr. C. C. Bonney, of the World's Congress Auxiliary.

An extended European tour on the part of Mr. Corthell during the summer of 1891 was the means of personally interesting many of the most prominent engineers of Great Britain, France, Germany, Holland, and Belgium, and in accordance with authority from the general committee he extended a preliminary invitation to some forty engineering organizations. The greatest interest

was everywhere manifested in the proposed congress, both at home and abroad.

It was at first agreed that the subject of engineering should form simply a subdivision under the department of Science and Philosophy. But, on account of the recognized importance of the profession of engineering in the world, it was made a department by itself, with seven subdivisions as follows:

Division A: Civil Engineering, in charge of the American Society of Civil Engineers.

Division B: Mechanical Engineering, in charge of the American Society of Mechanical Engineers.

Division C: Mining Engineering, in charge of the American Institute of Mining Engineers.

Division D: Metallurgical Engineering, in charge of the American Institute of Mining Engineers.

Division E: Engineering Education, in charge of Prof. I. O. Baker, of the University of Illinois.

Division F: Military Engineering, in charge of Major Clifton Comly, United States Army.

Division G: Marine Engineering and Naval Architecture, in charge of Commodore George W. Melville, Engineer in Chief, United States Navy.

The Engineering Congress will convene on July 31 and continue until August 5. It will be opened by a general session, followed by the various divisional sessions under the officers in charge, and close with a general session. There may also be joint sessions of two or more divisions on subjects of common interest; and the three national societies of the United States will make this congress the occasion of holding their annual meetings.

Invitations to participate in the Engineering Congress have been sent to all prominent foreign and American societies, institutes, colleges and schools of engineering, as well as to distinguished engineers in all parts of the world. Correspondence has been established with seventy-five societies in twenty-seven countries. This large foreign representation insures the international character of the movement, and, as this is the first international engineering congress in the history of the world, the result will be without doubt a successful representation of subjects of living interest to every engineer. There will be original papers and discussions by leaders in the profession in every branch, describing new processes, inventions, works recently constructed or in the process of construction,—in short, the advancement of engineering

in the nineteenth century. A complete list of the papers cannot yet be given, but among the more interesting of those promised the following may be mentioned :

Railways of the Far West, by V. G. Bogue.

Development of the Water Power of Niagara Falls, by John Bogart.

The Treatment of Metals for Structural Purposes, by James Christie.

Drainage and Sewerage of the City of Mexico, by Roberto Gayol, City Engineer of the City of Mexico.

Drainage of Chicago, by F. Benezette Williams.

Superstructure of Memphis Bridge, by George S. Morison.

Some Public Works of Russia, by T. Shmeleft, of Revel, Russia, one of the Public Counsellors.

International Navigation, by P. Caland—The Hague, Holland.

The Improvements of the Harbors of the Atlantic Coast, by Captain W. W. Black, United States Engineers.

Carbon, and its use in Electrical Engineering, by Clarence Barber, Cleveland, Ohio.

Four papers are promised from members of the United States Coast Survey, five from the Society of Engineers of Lisbon, Portugal, and many others from Germany, France, Austria, Holland, Italy, and South America.

In marine engineering such topics as the following have already been chosen : "Fast Trans-Atlantic Steamers," "Forced Draught," "Resistance of Ships," "Use of Oil at Sea," "Torpedo Boats," "New Battle Ships and Cruisers of the United States Navy," and many others, by the leading practical experts of the world in marine engineering and naval architecture.

In engineering education papers are expected from many eminent educators, among others : Professor Palmer C. Ricketts, Rensselaer Polytechnic Institute ; Professors George F. Swain and A. E. Burton, Massachusetts Institute of Technology ; Professors H. S. Carhart and M. E. Cooley, University of Michigan ; Mr. A. M. Wellington, of the *Engineering News* (New York) ; Professor Unwin, of London ; and Professor Armstrong, of Edinburgh.

Such names as the following can also be given as an indication of the high standard of the valuable technical literature to be contributed : J. G. Magnagli, Rear-Admiral Italian Navy ; Walter E. Lilly, of Trinity College, Dublin ; Percy Waldram, of the Engineers' Society of London ; The City Engineer of Messina, Italy ; Captain Fred. A. Mahan, United States Lighthouse Board ; and H. D. Hoskold, Inspector General of the Mines of the Argentine Republic.

The proceedings will consist of the papers prepared in advance

and accepted by the management of the separate divisions. A very large number of papers have already been secured and printed, and sent out for general written discussions. The papers will not all be read at length at the sessions, but brief abstracts only will be given, while some will be read simply by title. Then will follow the discussions, all of which have been prepared in advance. Such papers as are written in foreign languages are being translated by volunteers from the various societies, in order that correct technical interpretations may be obtained. Arrangements have been made for the printing of the entire proceedings of this congress, in a series of eight or ten volumes, thus presenting in compact form a valuable compendium of engineering literature. The various American societies have taken steps to defray the printing expenses of the papers in their own departments, while the department of marine engineering, having no national society to draw upon for funds, has succeeded in obtaining the coöperation of Messrs. John Wiley & Sons, of New York, for the publication of both the papers for advance discussion and the bound proceedings. It is expected that the papers of the Divisions of Military Engineering and Engineering Education will also be printed. Electrical Engineering, which was originally a department in the Engineering Congress, has been made, on account of its close connection with electrical science, a part of the Electrical Congress.

At the same time with the Engineering Congress, an international conference on aërial navigation will be held. The practical and partially successful experiments that have been made in the past few years on this still rudimentary subject have awakened the interest of the scientific and engineering world. Such names as Elisha Gray, H. S. Carhart, I. O. Baker, and E. L. Corthell and others as a committee, and Octave Chanute as chairman, insure a scientific and practicable treatment of a subject which for years has chiefly attracted only visionary inventors. The papers and discussions, all of which will be prepared beforehand and approved by the committee, will deal with the scientific problems involved,—aviation, ballooning, mechanical difficulties, etc. They will summarize the latest researches, and call for an exchange of ideas and concentration of action among men at work on this subject.

Another congress which will be held at the same time and which will be of special importance to engineers is the Water Commerce Congress. This is one of direct international impor-

tance, dealing as it does with that great economic question, the cost of transportation between States and nations. The cheapness of water transportation, as compared to that by rail, accounts for the steady increase of the former. In 1890 the entire cost of lake transportation in the United States was something over $23,000,000, while the cost of the same freight by rail would have been over $143,000,000. The subjects of this meeting will include building of canals, deepening of rivers, excavation of harbors, building of docks, improvements in steamers, proposed canals in the United States, and all relative topics, the discussions to be confined to the economic feature of water commerce. The executive officer of this congress is Professor William Watson, of Boston.

The Congress of Art and Architecture will very fittingly convene in the same week with the Engineering Congress.

Special efforts have been made to afford visiting engineers every opportunity to examine American works of engineering. A complete list of such works of note has been obtained from some 200 cities in the United States, and letters of introduction to any of these cities may be obtained from headquarters.

The local committee is entitled to the greatest praise for the ample and satisfactory provisions made for the reception and entertainment of visiting engineers. It became evident at a very early stage that some headquarters must be provided, both in the city of Chicago and at the Fair Grounds, where the engineers attending the Congress and Exposition could meet during social hours and obtain any desired information. To this end funds were raised, and accommodations were secured at No. 10 Van Buren street, in the city, and at the Fair Grounds in the Mines and Mining building. A staff representing the engineering societies is being maintained at these points, with stenographers, interpreters, etc. Visiting engineers will be received, given such information as they desire, made acquainted with one another, and in fact given a cordial reception in engineering circles in Chicago. The thorough and energetic manner in which the work of this congress has been undertaken and executed insures not only a series of meetings of the most vital interest and importance to participating engineers, but an ultimate crowning success in the form of a compilation of the latest and soundest engineering literature, which will be used for instruction and reference for many years to come.

STEAM LOCOMOTION ON COMMON ROADS.

By William Fletcher, M. E.

THE progress made in steam locomotion on common roads in England during the last few years has been very marked; the traction engine is rapidly supplanting the portable engine for driving threshing and food-preparing machinery, and for drawing the apparatus behind it from farm to farm. A large number of road locomotives of another type are specially built for drawing heavy loads at slow speeds, and employed exclusively for this work. The trade in this line of business for some time past has been particularly brisk, the orders mostly emanating from customers in Great Britain. Some firms are also shipping a considerable number of engines to the colonies and other parts of the world, most of the exported engines being of the slow moving class.

For the present we are not concerned with these slow-moving and ponderous road locomotives, but we purpose to consider another type of engine specially constructed for running at high speeds with light loads on ordinary highways. These quick-speed road locomotives would have been largely employed in England, if the legislative authority had not stepped in just as success was about to be realized, and, by a series of iniquitous laws, crushed this important industry in the bud. A certain class of influential people in England have a great objection to the employment on highways of any power except that of animals, and in their crusade against steam on the highway they have succeeded in curtailing the rights of traction-engine owners. Should these unfortunate proprietors of machinery happen to offend these fussy dignitaries, or frighten the wild creatures harnessed for their pleasure, they may expect to be treated with as little mercy as highway-robbers or sheep-stealers.

Some of the laws in force could be observed if a little extra care were bestowed by the drivers of the steam-engines; but the enactment that no locomotive shall travel at the rate of more than four miles an hour in the open country, and two miles an hour in towns, precludes the employment of the conveyances we are considering. However, it is hoped that these injurious laws may be

amended or repealed, and in the meantime high-speed road locomotives are used with some success in the colonies and other districts, where no such *useless* restrictions are in force. We say useless, because it is well known that these engines are now far more easily managed than many horses, as they can be run up or down hill at speeds of seven to ten miles an hour with safety. The drivers have the engines under perfect control, steering and maneuvring them in crowded places; they can stop them on the steepest inclines, and the traveling speed, if necessary, can be reduced when passing through towns. In many countries the want of such an engine already exists, and, if one can be introduced which is satisfactory in working, and economical in fuel and repairs, it will be sure of a market.

The very early history of steam on common roads will be briefly dealt with here.* It is generally understood that Cugnot, in France, made the first road locomotive that actually carried passengers. Murdock, Symington, and Trevithick in England, and Oliver Evans in America, made very creditable steam road-engines. The first two inventors made models only, but, when Trevithick approached the steam-carriage enterprise, rapid progress was at once apparent. Omitting the names of many steam-carriage promoters whose works are interesting, we may glance hastily at some of the more recent and fairly successful steam-carriages, in order to ascertain, if possible, why complete success was not achieved.

Hancock takes a foremost place among the steam-carriage pioneers. He made more coaches than any of his predecessors or contemporaries, and he ran some of them for months with great regularity through the crowded thoroughfares of London. Most of his later carriages were built on similar lines, the machinery displaying a large amount of ingenuity and engineering knowledge. The chief feature of the machine was Hancock's patent boiler, which worked admirably. The boiler was placed at the back of the coach. The engine was of the two cylinder direct-acting inverted type. The motion was communicated from the engine crank-shaft to the main axle by means of two strong pitch chains, and, as the chain wheels were very nearly on the same level, the springs of the carriage could act perfectly without interfering with the driving motion. One or both driving-wheels could be disconnected from the axle for turning corners when traveling, or run-

* Fuller information on the subject may be found in "The History and Development of Steam Locomotion on Common Roads," by W. Fletcher. New York: Spon.

ning the engine for working the feed-pump alone, or driving the fan for urging the fire. The waste steam was blown into a box for preventing noise before it was allowed to enter the chimney, and coke was used so as to avoid smoke. Thus there was no smoke, no steam, and an absence of noise from the exhaust or the machinery. The working parts were also out of sight, and these carriages caused very little annoyance to the public. A steam-pressure of 100 pounds per square inch was carried by the little boiler, and the traveling speed attained was from ten to fourteen miles an hour.

Hancock was a very modest man. His steam-coaches were tested very severely, and found far more successful than Gurney's, Maceroni's, Dance's, Ogles's, or those of other contemporaries, who boasted much and accomplished little. J. Scott Russell, the well-known designer and builder of the *Great Eastern*, made some coaches which were cleverly worked out. A contemporary, writing on Mr. Russell's death, which occurred as recently as 1882, said: "The springs of his steam-carriages, and the manner in which the machinery adapted itself to the irregularities of the road, were triumphs of engineering."

The failure of many of the early steam road locomotives was due to the want of proper materials, caused in most cases by the penury of the promoters. The design was often faulty, and the workmanship was invariably bad. The combination of coach and engine in one machine increased the difficulties, and another cause of failure was high-speed running on the worst possible roads. These carriage-builders injured their own cause by a foolish attempt to compete with railways, whereas such carriages can only act as feeders to the railways. In addition to these difficulties, prejudiced people did their utmost to place every conceivable obstruction in the way. Gurney's carriage was seized by an infuriated mob during one of the tests. "The steam-carriages of the early days," says one writer, "were hooted and hissed at by road authorities, coach drivers, publicans, and the multifarious men who delighted in horses, which perhaps was not to be wondered at, seeing that the interests of these men were at stake."

However, the road locomotives of to-day will have few of these difficulties to encounter, since the roads in many countries are rapidly being improved. In the colonies steam road-rolling is becoming more general, and good macadamized roads will soon be the rule. The macadam is undoubtedly the best for the high-speed

road locomotive and its train, and indeed for all kinds of vehicular traffic. The foundation of the road is made in the usual manner, the surface consisting of a layer of granite, or other road material thoroughly embedded in sand. A road-roller is used, and it should be heavy enough to squeeze the metal into its bed. The stones settle down with their sharp angles interlocking and their flat surfaces uppermost, for the road is made *for* the traffic and not *by* it. "The stones, instead of being left loosely upon the surface to encounter the grinding lateral pressure of the wheels, are forced by direct vertical pressure into the bed prepared for them, along with a binding material that fills up the interstices and—affording support for the stones—keeps them in position with one surface only exposed to the abrading action of the wheels. The whole coating is consolidated, and there remains a surface hard and smooth." Such a road will reduce the wear and tear of road locomotives to a minimum. But road engines are doing well in some foreign countries where the roads are anything but good. In France some road locomotives are successfully employed, and they have to traverse roads which, even when level, are full of great holes, and where open drains run across them without any covering. In many countries a macadam road is out of the question, but in the meantime we may state from experience that any road that is suitably made and maintained for ordinary vehicular traffic will do equally well for the use of the high-speed locomotive and its train. The latter, being spring-mounted and provided with broad wheels, will do little or no damage to any well-made road.

Mr. Fisher, in America, and Mr. Ricket, in England, turned their attention to this subject, and both these engineers proposed to separate the engine from the coach. The latter sent out several locomotives and coaches for passenger service in Spain, where the engines would draw a load of four tons, at 10 to 15 miles an hour. They were simple in construction, without any cog gearing, made almost entirely of wrought iron and steel.

Twenty-five years ago there was quite a rage for quick-speed road locomotives. A special type of engine introduced by Mr. Thompson was made by several of the leading firms in England, and sent to all quarters of the globe. This type was furnished with a separate tender behind for carrying the feed-water, wood, fuel, etc. Whatever success was achieved by these road steamers was due mainly to the india-rubber tires, for it is impossible to ignore these: they act as an excellent spring, and are

placed where the spring should be situated,—that is, at the point nearest to the road, thus saving the engine from a great amount of wear and tear and rough usage ; they are perfectly noiseless ; owing to their flexibility, they always possess a regular amount of surface of adhesion ; the injury to the road may be said to be *nil*, for there never has been any complaint on account of damage done by them ; and they enable a road locomotive to travel over the highway at a sensible speed.

The Thompson quick-speed road steamer is not yet an obsolete type, for one firm alone has built about sixty of these engines, and many of them are still doing good service, and where high speeds are allowed they will run eight to twelve miles an hour easily. In some districts where a number of these engines are used it is said that at first the horses were frightened, but they soon became accustomed to them, and would pass them without difficulty when the locomotives were traveling at comparatively high speeds. Another of Thompson's road steamers has attached a coach intended for passenger service. Engines of this type are now occasionally built, and possess many advantages, but the great cost of the india-rubber tires militated against their extended use.

Another English firm has recently made a goodly number of quick-speed road engines, several of which are running passenger trains in India, drawing an omnibus weighing two to three tons, at eight to twelve miles an hour. The engines are mounted upon wheels fitted with steel spring spokes. Three engines of this type, built for the *Fourgon poste* service in the south of France, are running regularly between Lyons and Grenoble, which are about seventy miles apart. This service consists of the collection and delivery of parcels and light merchandise, in districts remote from railways, or indifferently served by them. In France the prejudices of the authorities against steam on the common roads has been overcome, and several of the well-known Serpollet steam carriages are in ordinary use in the streets of Paris and other cities. The speed is restricted to ten miles an hour, and the experience is that horses are not frightened.

After reviewing the progress that has thus far been made in quick-speed road locomotion, we may consider the type of engine best adapted for the purpose. It will be impossible here to enter into minute details, but our remarks are the result of many years of actual experience with various forms of road locomotives. The ordinary traction engine of English make is successfully used for

heavy haulage purposes, and these engines with rigid wheels will run five or six miles an hour on level roads if allowed to do so. It should therefore be a comparatively simple matter to modify the details so as to enable them to run seven to eleven miles an hour. The standard type of traction engine is the survival of the fittest. We have seen some wondrous engines in the past, but *the best remains*, and it is the one that may safely be adapted for this purpose.

The engine and passenger omnibus are mounted on elastic wheels. The boiler decided upon is of the well-tried locomotive multitubular type. The engine parts are bolted on the top in the usual fashion. The sides of the fire-box shell are carried up, into which the bearings of the shafts are secured. Two speeds are provided for in this instance, the proportions of the gearing being modified for giving an accelerated traveling speed on the road. Our calculations are based upon a ratio of 5 to 1 for the fast speed,—that is, for quick traveling the engine crank-shaft would make five revolutions to one of the main axle; for the low speed the gearing ratio would be 8 to 1. As a general rule the quick speed would be used, the slow gear being intended for cases of emergency, such as mounting inclines, traversing bad roads, or passing through crowded thoroughfares. These proportions of spur gearing would cause the engine to run eleven miles an hour when driven by the quick train of wheels, and seven miles an hour when slow-gearing was in operation. The driving wheels are taken as being 6 feet 4 inches diameter, and the engine must make 250 revolutions per minute to obtain the above results. In order to suppress all noise caused by the gearing, the teeth of the wheels should be carefully pitched and trimmed, and the pitch of the teeth must not be too coarse. Pitch chains are less noisy than spur-gearing, and, when properly carried out, they form an excellent driving medium. Driving chains are now used on hundreds of traction engines in England. But cast-steel spur wheels are more reliable, and the noise must be prevented by carefully-formed cogs, and all the moving parts should be well cased in to further reduce the noise.

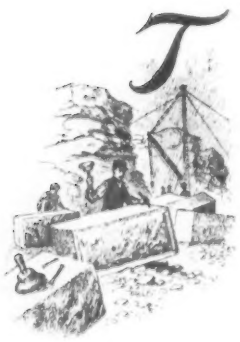
The weight of the engine must be cut down to the utmost limit compatible with the requisite strength of parts, and tractive force required to haul a load of coal of ten tons. This question of weight is an important one, because so many bridges outside of England are incapable of bearing heavy weights. We see no difficulty in making an engine with a single cylinder 8 inches in diame-

ter, having a stroke of 12 inches, working at 140 pounds pressure, that would easily give off the required power, the engine's total weight, fully equipped, to be about seven tons.

Some of our readers may ask why we specify a single-cylinder engine now that the compound system is coming into favor? We recommend the simple engine because it is handier, lighter, less costly, and has fewer wearing parts. The compound system does secure a small saving in fuel, and it is less noisy than the single-cylinder engine, but experience shows that the economy of the compound type when compared with the simple engine, both working at 140 pounds boiler pressure, is less than some makers specify. Moreover, the simple engine possesses advantages that the compound engine cannot claim, rendering the former engine more suitable for unskilled drivers, and colonial work generally. Ample tank capacity would be provided, so that the engine could travel long distances without stopping to take in water. Coke might be mixed with the coal so as to reduce smoke, and the noise from the exhaust nozzle could be suppressed. Quick running is out of the question unless the engine is mounted on springs. Although many spring-wheels have been introduced lately, few have survived. None of the wheels with elastic spokes answer as well as the india-rubber tires. A good form of spring-wheel has been used on some steam coaches, "consisting of an iron boss and about one-quarter of the quantity of india-rubber put round the boss of the same thickness as in the Thompson type. Impinging upon the india-rubber were blocks of wood endways of the grain held between two steel-plates in which they could work in radial slots, and those blocks rested upon the road, affording the same flat surface that the Thompson tire did, and giving considerable tractive power." Many other details of these quick-speed locomotives might be referred to, but space is wanting here. Careful drivers can do much to render the machinery inoffensive to horses, and as these engines become more numerous the horses must be trained to meet them without fear. Indeed, we believe that the horses would soon be reconciled, if the drivers and *riders* of these animals did not *shy* at road locomotives.

MECHANICAL AIDS TO BUILDING.

By George Hill, M. Am. Soc. M. E.



THE treatment of this subject requires that we bear in mind that, broadly speaking, every step is included from the time when we take the raw material from mother earth until, having passed over long distances, through multitudinous processes, and many hands, the finished products of many an industry are laid down at the site as the raw material from which the future building is to be made. We might then, look on our subject with so broad a view as to see it in its entirety, and attempt so to treat it. But if we should, we would have an interminable series of papers, impossible of satisfactory treatment by one mind, no matter how great its experience or how broad its knowledge.

This being the case, we shall confine our consideration at present to those mechanical operations which take place on or about the site, illustrating present practice. If our first thought were to to be followed, we would also establish a comparison of the methods of to-day with those of a generation back, but a little study would show that the advance has been but little and that we are only now beginning to realize what might be done.

The first step in the journey is the preparation of the site for the future building, and this is proceeded with variously, according to the conditions involved. It may be that the site is a mass of rock rearing its head above the street, to be subdued only with steam and dynamite. We would then start a rock-drill of one of the well-known types [Figure 1] usually driven by steam furnished from either a locomotive boiler [Figure 5] or an upright boiler [Figure 6], where the boiler is shown in conjunction with hoisting apparatus, or [Figure 11] in connection with a pump, or one of the electric drills, [Figures 2 and 3] driven by current from the street. It is quite probable that in order to get the boiler to the site the team dragging it would have to wallow through the mire of an un-

paved street; but that is one of the beauties of our civilization. It is also more than probable that the shell of the boiler would be left entirely uncovered, radiating from each square foot of surface then heat-units at the rate of 400 per hour, under ordinary conditions, which means 6 pounds of coal for the average boiler when the temperature difference is 200° F.

To farther carry out the same idea, the piping to the rock-drills is usually of bare wrought-iron, and at least a portion of it is conveyed through flexible hose, none of which is protected. This is well shown in Figure 4, where the bare steam-pipes can be distinctly seen. The blasting, although not done with that degree of art

FIG. 1.—STEAM ROCK-DRILL.

employed in the large quarries, still requires very considerable skill on the part of the foreman to prevent flying rocks from injuring adjoining buildings, and to avoid shaking them injuriously, but generally the results are satisfactory.

If, instead of having rock to deal with, the site should be near the old shore of the river or lake, as is the case in some part of almost every large city in the world, with silt, clay, sand, and gravel mixed together, or if the site is alluvial and the characteristics of the soil unknown, test-bearings become necessary, and we require mechanical assistance in making them.

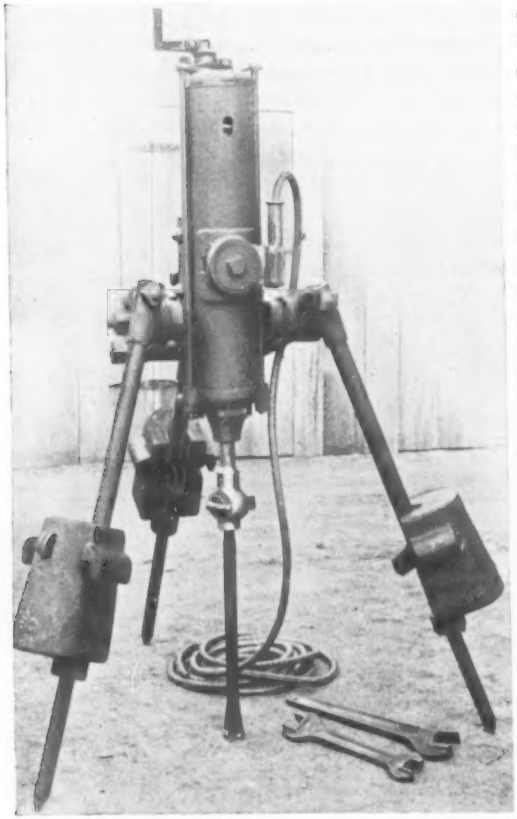


FIG. 2.—RECIPROCATING ROCK-DRILL.
[As durable as a steam-drill; requires a special generator for the electric current.]

If the soil is compact and of very considerable depth, an exaggeration of the primitive auger is often used, and occasionally used successfully for depths of about twenty-five feet. The auger is turned down by hand and then withdrawn with a sample of the soil fast in it; or a pipe may be driven down and the soil removed from it with an auger, or a

FIG. 3.—ROTARY ROCK-DRILL.

[Handled with the same ease as a steam-drill. Can be used with any continuous current generator.]

FIG. 4.—STEAM-DRILLS AT WORK.

[Boom derricks to the left for removing rock.]

sand pump, which is simply a short length of pipe with a clock valve at the bottom, the cutting of the pipe as it is forced down affording the samples; or it may be found desirable to sink a considerable number of holes round the site, or to go to a considerable depth. In this latter case a machine like that shown in Figure 7, which is the one used by Professor Charles B. Brush, may be employed. This machine is similar to a pile-driver, the pipe being driven down by the use of a light ram. As it goes down water is pumped through an interior tube, shown beside the barrel and connected with the pump by means of a flexible hose. The water flows up in the annular space between the two tubes, carrying in suspension such of the material passed through as would otherwise fill the pipe; samples are recovered from the water by settling. The purpose of the tests being to determine the safe load that can be placed on the soil, it is necessary that the engineer who expresses the judgment should be familiar with the method employed to obtain the samples so as to correctly interpret them.

FIG. 5—SEMI-PORTABLE LOCOMOTIVE BOILER.

It occasionally happens that the building is to be erected along what was formerly a river front, or where the ground has been

filled in to level an inequality. This requires that the bearing value of the soil be determined in a different way, and the only satisfactory method is by driving test piles. For this purpose a pile driving machine [Figure 25] is used, and the behavior of the pile under the hammer observed by an expert; the amount of penetration under each blow, the weight of the ram and the height of the fall, the size and material of the pile, all are necessary elements. Instead of the machine shown in Figure 25, which is the old style, one of the newer kinds shown in Figure 8 might be used, in which a greater weight is made effective.

Should the conditions of the case require that the piles be driven over the site, the pile-driver would remain on the site and continue its work; the piles being driven in such a manner as to either effect the consolidation of the soil or reach to a solid stratum, or support the superimposed load by means of friction be-

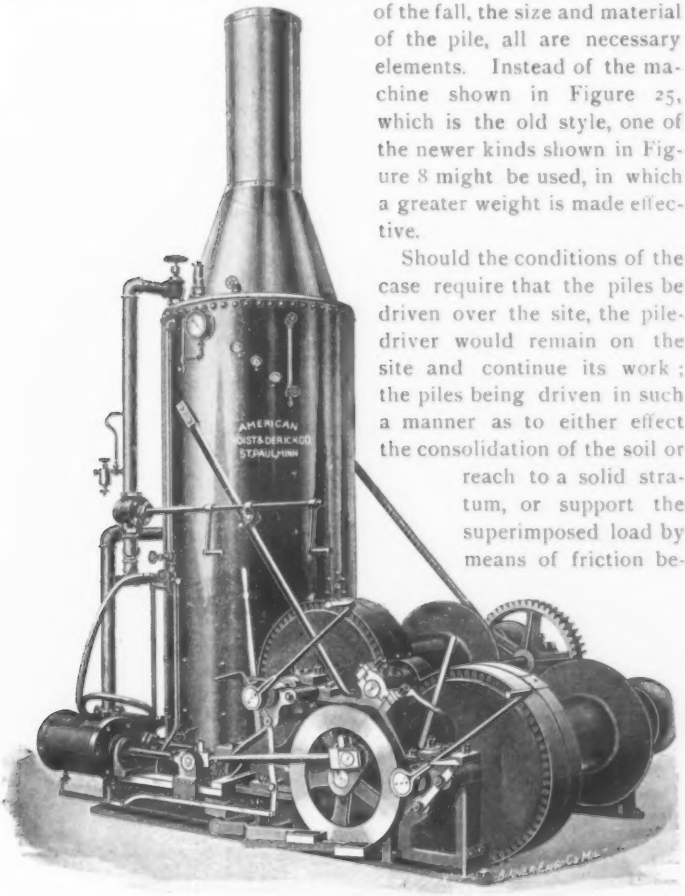


FIG. 6—UPRIGHT BOILER.

[With cast-iron base, double cylinders, double hoisting drums, and two winch heads.]

tween the mud and the skin of the pile. In any case the fact must be borne in mind by engineers that the proportion between dead load and live load in the case of a building is altogether different from that in the case of railway bridges and the like, and that a pile

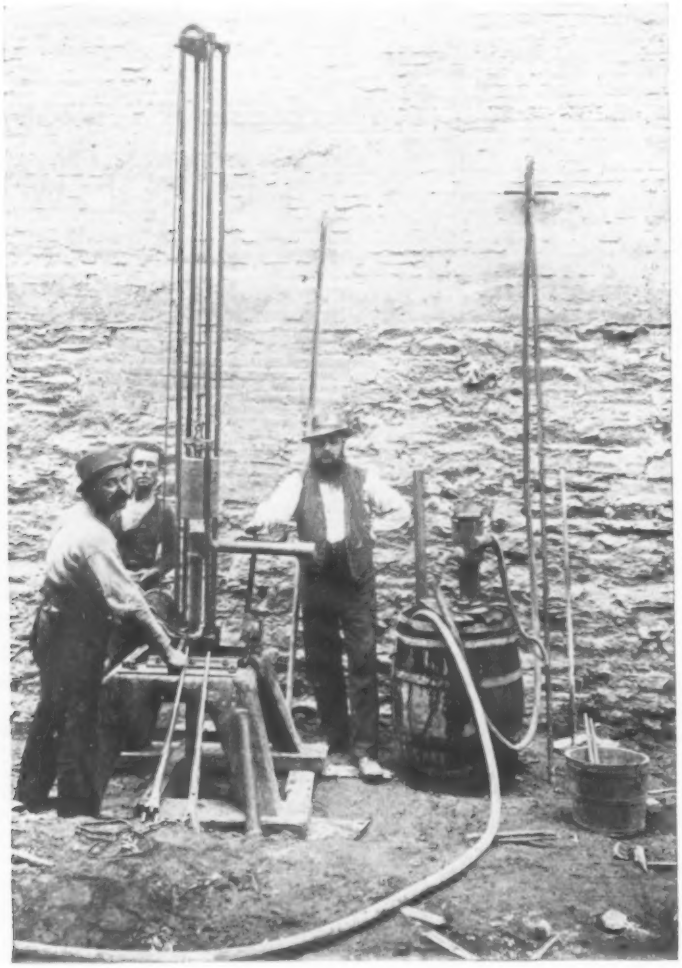


FIG. 7.—BRUSH'S SOIL-TESTING APPARATUS.

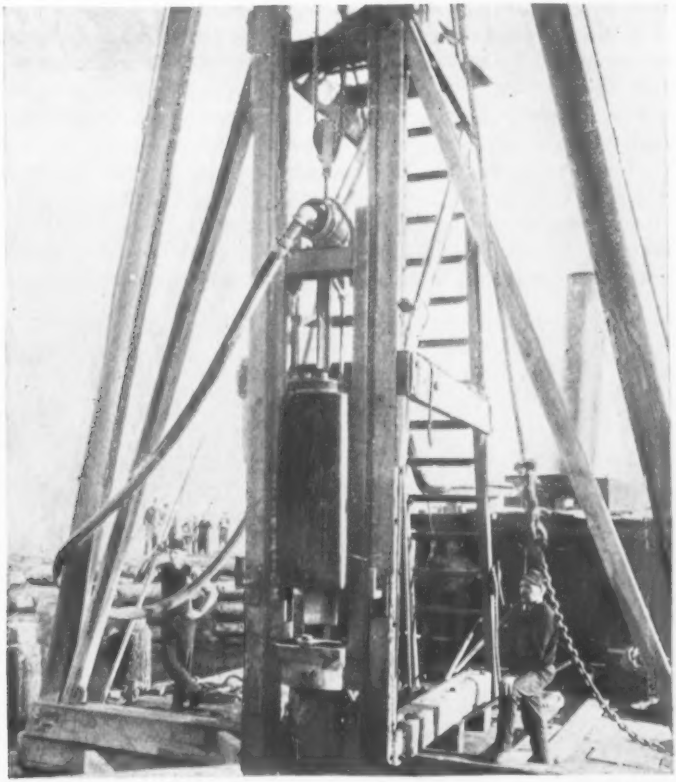


FIG. 8.—STEAM HAMMER.

[The operating piston is inside the weight. The steam-hose passes in front of man to left. Valve is in the sphere between the ways.]

would often fail under the prolonged application of a load very much less than it would safely withstand for a few moments. For this reason the formula usually adopted for the safe load of the piles cannot be used without modification. This being the case, the objection of some engineers to having the fall fastened to the hammer permanently, on the score of friction losses, is rather hypercritical. Were the amount of excavation large we might use one of those forms of excavators of which a type is shown in Figure 9.

If the soil is sandy or soft, sheet piles will be necessary to keep

it from caving in, and that, by an application of the steam rock-drill [Figure 10], can be most easily done ; oftentimes a large wood mallet is used instead. Should it be necessary to keep the excavation free of water, we can use one of the Worthington pumping outfits [Figure 11] or one of the Pulsometer outfits [Figure 12], each having a use to which it is best adapted.

We may now consider that the site is ready for the building, and proceed to put in the foundations. Where these are of large stones, they may be handled either by means of moderate sized erecting derricks, the stones being dropped on to the ground, and then carried by means of rollers running on planks to a

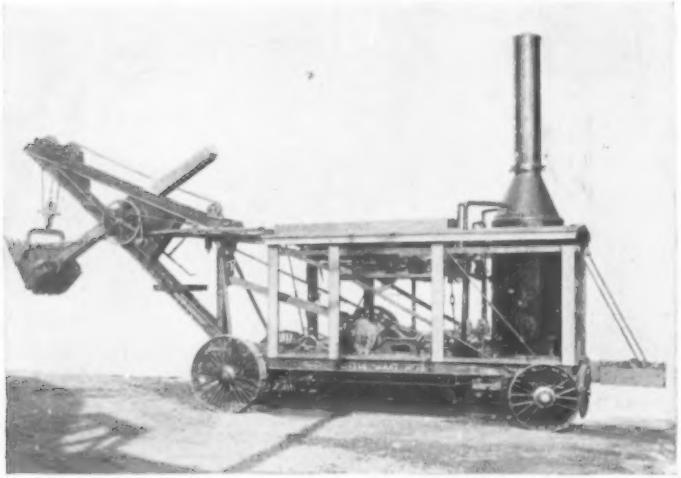


FIG. 9—PORTABLE EXCAVATOR.
[Self-propelling type, with ¾ yard dipper.]

position under the derricks, the derrick lifting them up while a bed of mortar is being prepared for them and then lowering them into it, or else one or more boom-derricks may be used, which take the stones from the vehicle and deposit them either under the erecting derricks or in their proper place in the work. Some of these are shown in Figure 4 ; a very good type is also shown in Figure 13.

These derricks are used throughout the balance of the construction and put in place the iron, steel, stone, or timber that may

be needed. Where the work is of considerable size, skeleton derricks of the Norcross type [Figure 14] are used; these are so arranged that the swing of the boom includes every portion of the site, and material may be passed by them entirely around the building. They are also arranged as crane derricks, as shown in Figure 15. If in addition to considerable area the building is of great

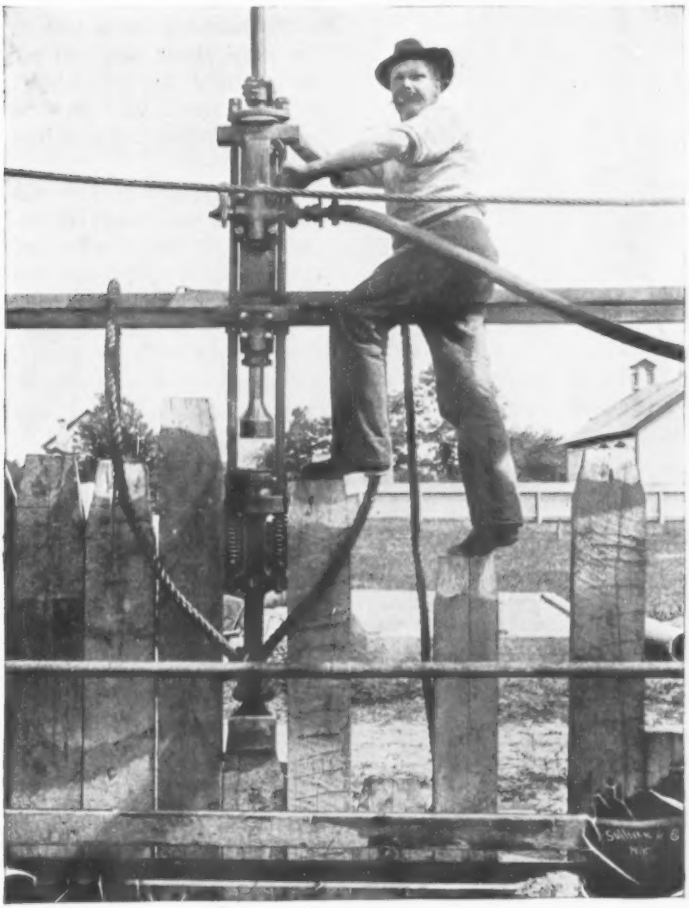


FIG. 10—STEAM SHEET PILE-DRIVER.

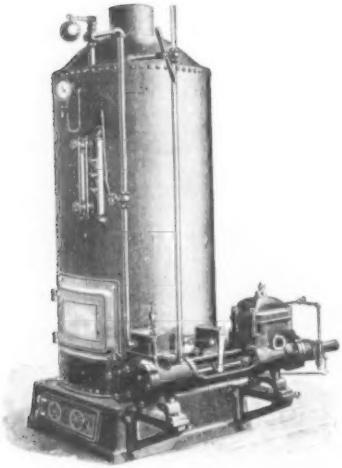


FIG. 11.—PUMPING OUTFIT.

height, the plan adopted in the erection of one of the Chicago buildings may be very successful. In this the hoisting-engine, which was really a traveling crane, traveled on a track laid just within the exterior walls of the building, and as soon as the story above was erected, pulled itself up an inclined plane to tracks laid on that story and proceeded with the erection.

A similar arrangement has been used with small boom-derricks in the erection of many of the Massachusetts mills. The mast of the derrick in this case is lifted vertically by means of the fall from floor to floor as the work progresses. Where large derricks are employed it has been found to be particularly advantageous to have the bricks used in the erection of the building packed in boxes of a special size, usually arranged to

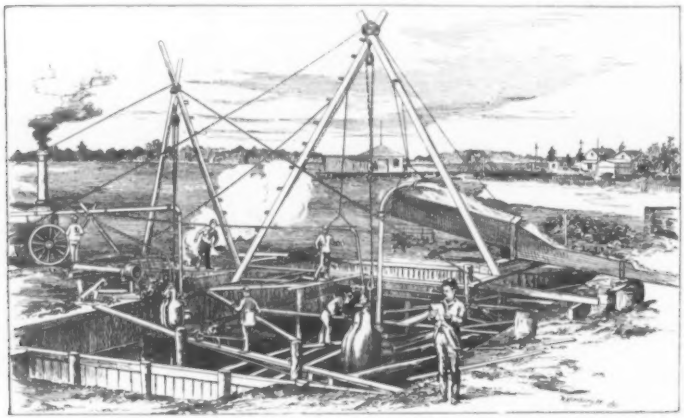


FIG. 12.—SEMI-PORTABLE PUMPING OUTFIT.

[Pumps are lowered as the pit deepens.]

FIG. 13.—BOOM DERRICK.

[Steam power, braced tubular mast and boom. Capacity five tons.]

contain 2800, which fit comfortably in the wagon-body and have means provided whereby the derrick can lift them out at once into the work. A particularly good example of this and of the skeleton derricks may be illustrated by the erection of the Equitable building in Denver. [Figure 15.]

For the handling of the mortar, the usual method is to mix it by hand in boxes somewhere around the site, hoisting the hods filled with it up to the working floor ; and this is done either in an elevator of the usual form or in a hod-hoisting machine consisting

of an endless chain rotated over sprocket wheels and carrying the hods in claws fastened to the chain. The usual form has the lift operated by means of an engine lift, shown in Figure 6. If, however, the contractor is very much up to date, and is using a mortar-mixer for the cement mortar and for the lime mortar, he may send it in boxes of the proper size to the building and deliver it to the working floor without breaking bulk, or the ingredients may be delivered and the mixing done on the floor where the work is being prosecuted. The advantage of so doing depends on the perfection of the organization of the force and is at times a minus quantity.

From recent experience in Chicago in the erection of the World's Fair buildings, it is probable that in the large cities a change will soon be introduced in the motive power of these various machines, and the illustrations heretofore given will have more of an historical than a practical interest, in their details.

In Chicago, in the erection of the buildings for the World's Fair, electricity played a prominent part, and some of the uses to which it was put are illustrated in Figures 16 to 23, where it is

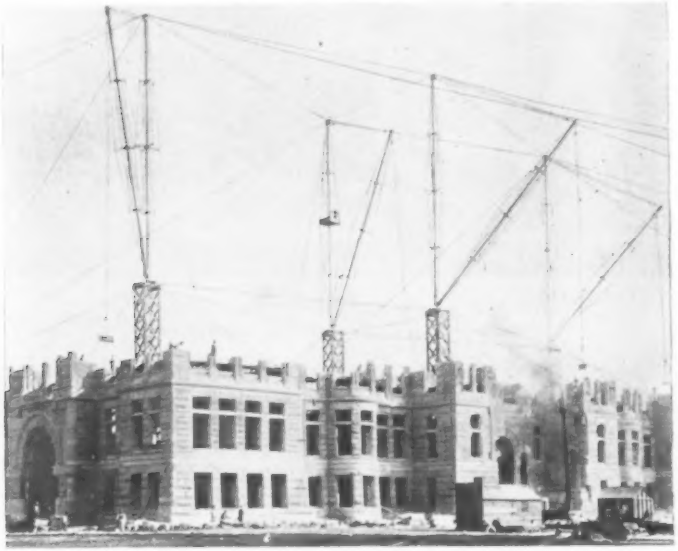


FIG. 14—SKELETON BOOM DERRICK.

[Braced tubular mast and booms, steam power. Used in erecting the City Hall and Court House, Salt Lake City, Utah. Masts 80 feet, boom 75 feet, capacity five tons.]

shown sawing and planing wood, painting, erecting materials, etc., and in all of the operations we have been describing, it could be used in lieu of steam except, perhaps, only in the case of the pile driving machine, where it is probable that, owing to the peculiar conditions of the service, either an excessively large machine would have to be used, or one of a different type devised with a means of storing up energy. It is to be noted however that this has been very successfully done in France, although the details have not been published.

To effect a comparison consider the two cases in contrast. In the one case triple expansion condensing-engines of considerable power working under a uniform load, tended by competent assistants and generating a current which is sent over a few miles of line and is ready at all times for immediate use. This should mean an expenditure not to exceed two pounds of coal per actual horse-power hour. If we allow for an equal amount lost in transmission, and to cover cost of plant, etc.,—and this should be extremely liberal,—we should have an expenditure of four pounds of coal per horse-power

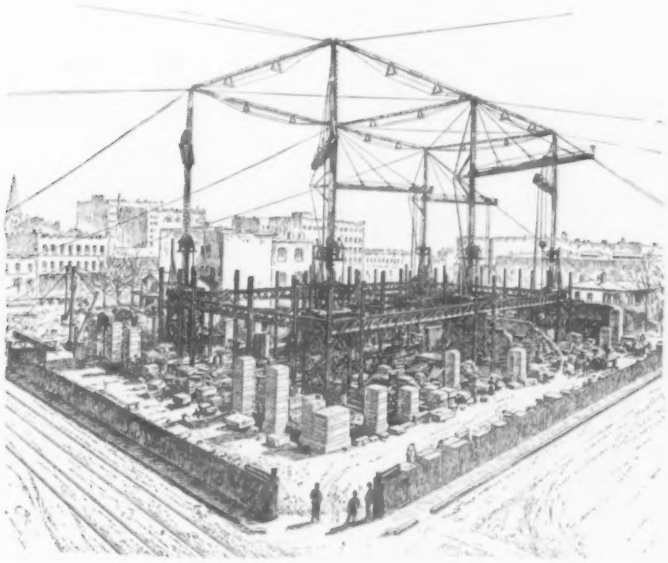


FIG. 15—SKELETON CRANE DERRICKS.

[Hand power, masts braced; used in the erection of the Equitable Building, Denver, Colorado.]

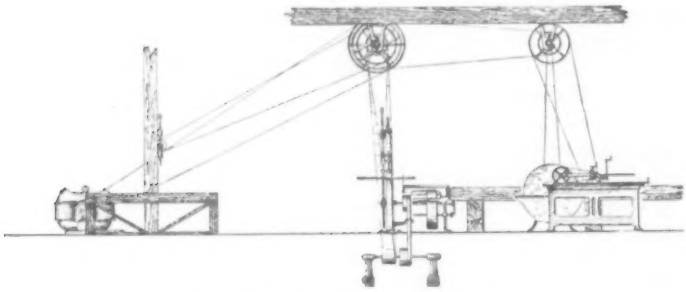


FIG. 16—SAW-MILL IN AGRICULTURAL BUILDING.

[Twenty horse-power motor driving boring machine, band-saw, rip-saw, cut-off saw, and grindstone.]

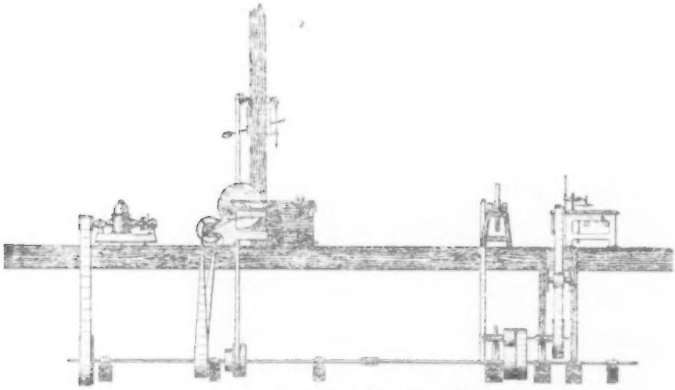


FIG. 17—SAW-MILL IN MACHINERY HALL.

[Twenty-five horse-power motor running same tools as in Fig. 16.]

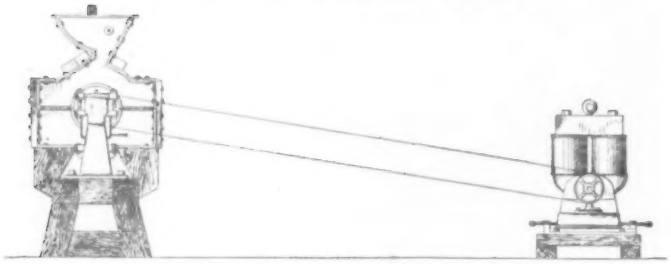


FIG. 18—AUTOMATIC PULVERIZER AND MOTOR.

[Pulverizing clay for modelling.]

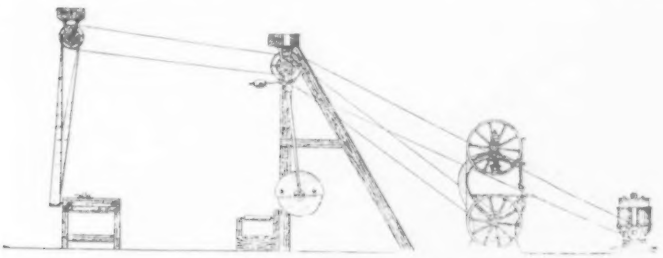


FIG. 19—SAW-MILL IN ELECTRICITY BUILDING.

[12 kilowatts motor running band-, rip-, and cut-off saws.]

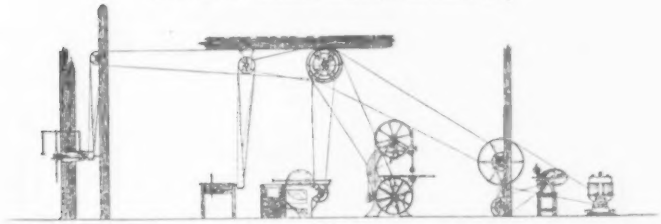


FIG. 20—SAW-MILL IN MANUFACTURE BUILDING.

[12 kilowatts motor operating saw-sharpener, band-, rip-, and cut-off saws, and boring-machine.]

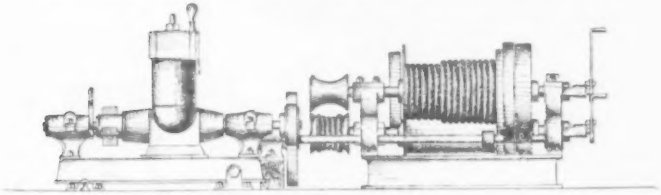


FIG. 21—ELECTRIC HOIST.

[Double-friction drums, double winch-heads, independent bases—practically a detail of Fig. 23. Rawhide pinions used.]

per hour, consumed while work was actually being done, using coal of the cheapest grade under boilers of the most economical type, and most carefully guarded against loss.

On the other hand, the type of boiler most freely used in building operations is the vertical tubular with short tubes, unjacketed shell, and more or less out of order, and such as to require the consumption of at least six pounds of coal per horse power per hour, the coal being of double the cost.

The engines which transform the energy of the steam into useful work are usually of the most ordinary kind, with steam follow-

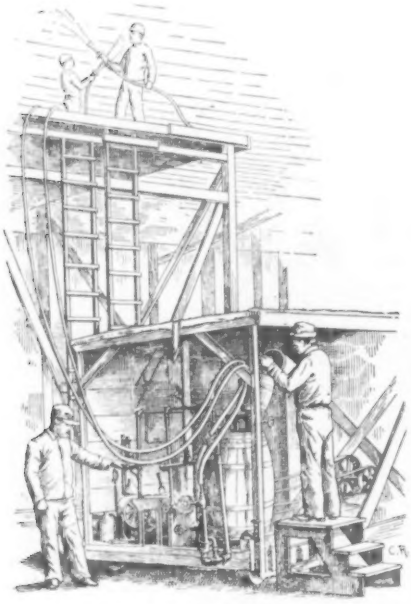


FIG. 22—PAINTING MACHINE.

[Used at the World's Fair. Motor drives small air-compressor. Paint applied on the same principle as the air-brush.]

ing practically full stroke, controlled by means of a manually operated throttle valve and generally left to care for themselves. So far as the writer can learn, the consumption of coal is in the neighborhood of twenty pounds of coal per horse-power per hour. Add to this that the engines are working but a short portion of the time while steam is kept up ready for any call upon it, usually blowing off at the safety-valves, and the enormous consumption of coal is easily accounted for.

Enough has been indicated to show that such wasteful methods cannot be continued and the assertion made in the early part of this article justified. As a further illustration

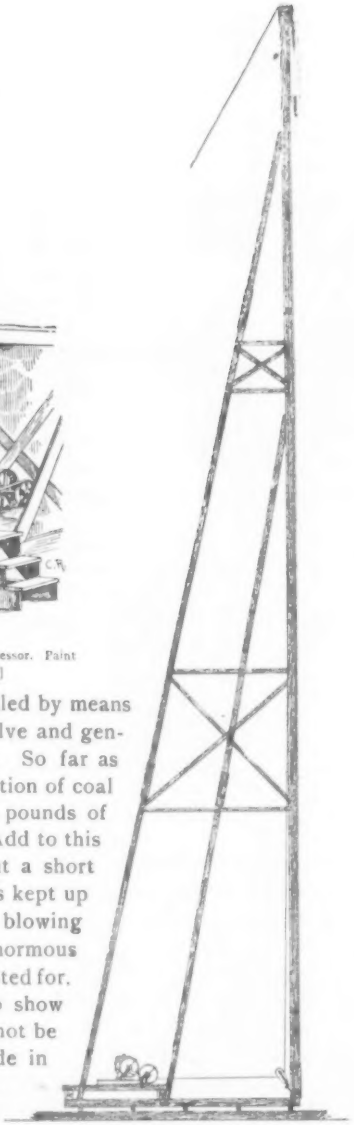


FIG. 23—ELECTRIC HOIST.

[20 kilowatts shunt-wound motor.]

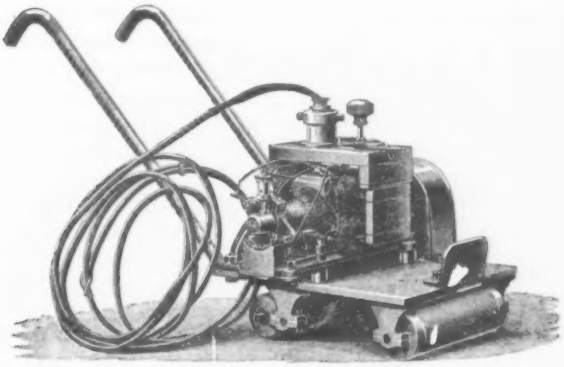


FIG. 24—DECK-PLANER.

[Could be used for planing floors if slightly modified.]

of the same fact, witness the uses made of electricity at Schenectady, N. Y., where the Edison Company have a motor in a house on a crane like that in Figure 13. The painting machinery at Chicago [Figure 22], the deck-planer, equally applicable to floors [Figure 24], the very satisfactory operation of rock drills, one of

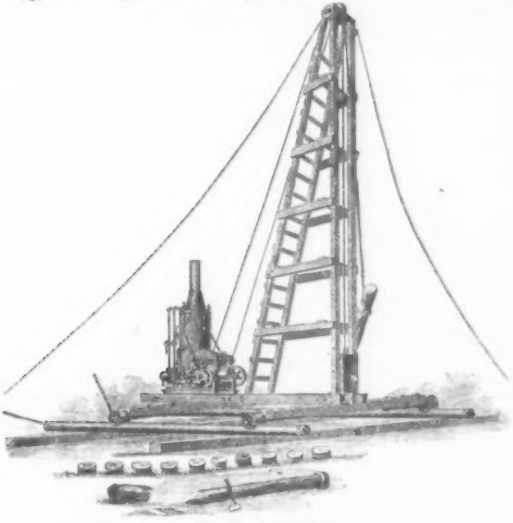


FIG. 25—PILE-DRIVER.

[Single cylinder with two winch-heads; single hoisting drum and improved rolling gear.]

rotary type being shown in Figure 3 and of reciprocating type in Figure 2, and the fact that one of the regular manufacturers of hoisting machinery is now making electric hoists, would make it truly seem as though electricity were the coming power.

That this is so will probably be admitted. Where there is ample opportunity for procuring power at a moderate rate, it is probable that its convenience will lead to its universal use.

There is, however, in a gas-producer and gas-engine and in a natural-gas country the probability of a still more economical prime mover. In this case the use of the double cylinder so common in the hoisting rigs would be kept up. The engine would be constantly in motion, and the probable result would be an economy in fuel approximating two pounds of coal per horse-power per hour of actual work performed, and this coal the common pea coal.

It would be but a simple matter to carry the gas made either in one of the usual forms of portable producers or taken from the pipes in the street, through pipes in the building up to the place where it was needed; the method of distribution being such as to make it readily applied in pipes of moderate size. So far as the writer knows, no attempt to demonstrate economy in this line has as yet been made, and therefore no data can be given; but it seems as though it would be worthy of investigation.

THE SAFETY CAR-COUPLER PROBLEM.

By W. M. Mitchell,

Kansas Board of Railroad Commissioners.

IT seems hardly possible for one to say anything on the question of safety car couplers that has not already been said ; yet the passage by the United States Congress of a law bearing directly on the subject has created a new public interest and must of necessity awaken further discussion. Heretofore discussions in this field have been principally prospective, but now the subject has assumed definite form. In times past the various advocates of safety appliances have made vigorous use of the fact that a large number of our citizens are annually either killed or injured (as chronicled in the newspapers, showing a frightful mortality from this source), for the purpose of inciting a public clamor for legislation on the subject. Such efforts were attended with varying results until recent political disturbances indicated to the alert and wily politician, who is ever ready to grasp that which bids fair to yield the greatest returns in the way of ballots at future elections, that the time had arrived when the long-promised action on the question of safety appliances must take definite form, in order to secure in the future, as in the past, the class of votes affected by such legislation. The result was that on March 2, 1893, a bill providing for automatic couplers and power-brakes passed both branches of Congress, was laid before the president, received his signature, and became a law.

The bill, in brief, provides that on or before the first day of January, 1898, it shall be unlawful for any railway company doing an interstate business to employ in such traffic any car or cars equipped with automatic couplers that will not couple by impact, and that they must not run any train in such business that has not a sufficient number of cars equipped with power-brakes to control the speed of the train, without compelling the brakeman to use the hand-brakes for that purpose. It would seem that a measure providing for uniformity of automatic couplers, coupling by impact, that can be uncoupled without forcing the employé to go between the ends of the cars to perform that duty, and obviating the necessity of going on top of a moving train to regulate its speed, would

forever avert a source of death and injury which has been fruitful in the extreme.

A few statistics at this point, by way of illustration, may not be uninteresting, and will demonstrate that there was a necessity for legislative action. The Interstate Commerce Commission has given careful and painstaking attention to this question, and its conclusions are as trustworthy as any that can be obtained. I quote from their report for 1890:

> The most common accidents to which railway employés are liable result from the coupling and uncoupling of cars. The casualties that can be traced to this source alone are 8212, of which 369 were fatal; of this number, trainmen sustained 5338 accidents, 265 of which were fatal.

In other words, one third of the accidents upon railroads can be traced to coupling and uncoupling cars. The adoption of these safety appliances will not only materially reduce the accidents to employés in coupling and uncoupling cars, but also eliminate the item of "falling from trains and engines" and "overhead obstructions." Using the figures found in the same report, we find that 42 per cent. of the number of employés killed and 47 per cent. of the killed and injured are traceable to the three above-mentioned causes.

There were in use on the railways reporting to the Commission forty-five different automatic couplers. In 1889 there were 80,510 cars equipped with various kinds of automatic couplers, and in 1890, 115,319,—an increase in a single year of 35,809 cars. This should have reduced the number of casualties, and would have done so in my opinion, if the couplers had been of uniform type, but as a matter of statistical record there is no decrease in the number of casualties from the preceding year.

It has been claimed by many that the general trend of railway practice was toward the adoption of automatic couplers, yet it cannot be denied that it required some such act as the one mentioned to secure complete uniformity, and render to the employé as nearly absolute protection from accident as it is possible to attain under the present mode of operation of our railways, which is hazardous at best. It has been remarked that there are certain inherent difficulties attending the coupling and uncoupling of cars under the best conditions that render the service dangerous in any event, and that this fact is to a degree responsible for the large number of automatic couplers that have been invented, which is no doubt true to some extent. Yet it is hardly possible that the inventors in all in-

stances have been moved alone by philanthropic motives in their work. The difficulties referred to are numerous, and to the experienced railroad man are as familiar as the cars themselves,—for instance, the coupling and uncoupling of cars standing on a curve, or those of uneven height, or cars loaded in such a manner that their burden projects beyond the ends, and which, when placed in position to be coupled, come in collision with each other. This latter difficulty is met more frequently in the construction of railways when the cars handled are loaded with bridge timbers, rails, piling lumber, etc.

The dangers above enumerated are largely increased by the unevenness of the roadbed and the neglect of surfacing to a level with the tops of the cross-ties. This needed work seldom reaches to the outside of the rails except in the large yards at terminal stations, and, when the train-men are forced to couple or uncouple a moving car, they must either get clear inside the rails and take the chances of stumbling over some unseen object, which means almost certain disaster, or run along on the outside of the rails over the exposed ends of the cross-ties, an extremely hazardous undertaking, especially when the rails are covered with ice or snow. Last, but not least, come the lurking dangers of the unprotected switch-frog and guard-rail, which have been one of the most prolific sources of accidents in the railway service. The unwary employé in the hurry of making up a train, who was obliged to step between the moving cars to make a coupling or pull a pin, and unwittingly forced his foot into a switch-frog or between the guard- and main-rails in such a manner that it would be held as if in a vice, was in danger of being crushed before the foot could be extricated.

These reasons, as stated, are largely the cause of bringing into this field the genius of the inventor, who sees the necessity for some immediate protection from accident to the thousands of our citizens who are engaged in this hazardous and necessary employment, the result being a great number of inventions in the direction of safety.

It will now be seen that where there has been no concert of action in selecting the most practical coupler to put in use, and where each individual railway official has been left to his own choice in the premises, a large variety rather than a uniformity of couplers must of necessity have been the inevitable result. It could be no more expected that the same type of coupler would be

selected by all the railways than that all men would crave the same food or enjoy reading the same book, or that in the selection of a profession all men would elect to become lawyers, or doctors, or ministers. It is human nature for men to differ in business methods as well as tastes; hence the reason for a disparity in safety couplers and the necessity for legislative action along the line set forth in the bill of March 2.

It cannot be gainsaid that the railways under past circumstances have been as progressive as could have been expected, yet, under the conditions attending the early days of railway building and operation, there was a wide disparity of gage, which was intensified when applied to the rolling-stock. There were not in those days, as at the present, independent shops for the manufacture of cars. Each road had a shop of its own, with a master car-builder at its head, whose peculiar ideas regarding the architecture of the cars to be built under his supervision resulted in each road placing cars upon its tracks which, when interchanged with other roads,—when the gage would permit,—were as easily distinguished by their general outlines as by the inscription on their exterior, and this peculiarity of shape was no more prominent than that of its coupling-device, whose size, shape, and height, from the top of the rail to the center of the drawbar, lent its influence to increase the dangers of coupling and uncoupling cars.

The first noticeable step in the line of progress towards uniformity was the change of gage, a step forced by the demands of commerce, but of course not affecting the construction of cars. There was no marked improvement in this direction until the business of the railway companies increased to such an extent that they were unable to construct their cars as rapidly as their business demanded, and they were forced to purchase them from the companies that had in the meantime been organized for the exclusive purpose of constructing rolling-stock. Thus the step toward the era of uniformity in height and shape of cars was entered upon.

Barring the existence of many thousands of cars already constructed, in such good condition that the companies could hardly be expected to discard them for the sake of uniformity in their rolling-stock,—which is a very plausible argument that can be used against the taking effect of the act until the old cars shall in the course of events have outlived their time of usefulness,—there is but little room for argument why the act

should not become effective. Yet this reason cannot be given for not complying with the requirements of the law in the construction of new cars, or of old ones sent to the shops or repairs, by placing upon them some type of coupler that will successfully intermingle with those of other roads and that can be coupled and uncoupled without the necessity of the employé entering between the ends of the cars to perform that duty, as required in the above act.

It was urged by many who opposed the passage of the act that, if its provisions were enforced, the railway companies of the United States would incur an expense of at least $75,000,000. Perhaps that amount would cover the expense, but would not the expenditure of $75,000,000 be a good investment if it insured the protection from injury of 22,396 persons and saved the lives of 2451 more every year, to say nothing of the wrecks, with their attendant loss of property, delayed trains, damage suits, etc.?

This law strikes a direct blow at the root of the evil of non-uniformity of couplers, in providing that they must be susceptible of intermingling, coupling by impact, etc., and it would have been difficult for Congress to have done more and protect the rights of all,—the inventor, the employé, and the railway companies. The act as it stands leaves open to the inventor the field of competition. It does not bind the railway companies to the adoption of any certain coupler, and thereby subject them to the possible unreasonable exactions of the fortunate inventor whose production might have been selected. At the same time it insures to the public and employés the protection so long sought, by providing that the coupler adopted must contain certain elements of safety; hence it would be difficult indeed to suggest an improvement to so wise and far-reaching a measure.

The fact that this act of Congress has been signed by the president and has become a law raises the question as to type of coupler best calculated to meet the requirements. In this discussion we should not lose sight of the diverse interests that must enter into the determination of so momentous a question. The rights of the inventor whose production is possessed of more or less merit, those of the railway companies with their numerous varieties of couplers already placed in use, and the elements of safety that must be considered as the rights of the public and the employés, must all be kept in mind.

ELECTRICITY.

Conducted by Franklin L. Pope.

PROFESSOR MOSES GERRISH FARMER, of Eliot, Me., who died in Chicago on May 25, although but little known to the present generation of electrical workers, was one of the most accomplished electricians, as well as one of the most remarkable men of his time. Born in Boscawen, N. H., in 1820, he manifested in early life great ability as a mathematician and a strong predilection for scientific pursuits. Illness and lack of means constrained him to relinquish his studies while yet in the midst of his college course, and to seek employment as a teacher. In 1845 his attention became directed to the study of electromagnetic phenomena, and from that day to the end of his life he devoted himself with unbounded enthusiasm and unceasing diligence to the study of electrical science with reference to its industrial applications. It is not too much to say that almost the whole art of electrical engineering in the United States has been built upon the foundations which he laid. He entered the telegraphic service in the capacity of operator and inspector in 1847, having previously invented and built an electric locomotive, and acquired some local fame as an experimental lecturer on electricity and magnetism. His first notable achievement was the construction of the municipal electric fire-alarm of Boston, which he completed in 1851, a work which properly takes rank as the beginning of the art of scientific electrical engineering, not only in the United States, but in the world. The differentiated automatic signalizing apparatus; the control of powerful mechanical forces at a distance by a feeble electric current; the constantly closed circuit in which signals are given by interruptions; the application to such circuits of the sustaining battery; the application of the magneto-electric current machine for the production of currents of great dynamic power, and of water-power for driving the magneto-machines; the protection of conductors by placing them, insulated, in wrought-iron pipes; the protection of the signal stations from the destructive effects of lightning by the "plate-arrester,"—all these and innumerable minor devices essential to the efficiency and trustworthiness of the system had to be originated by him, for there existed at that early day no precedents by which he could have been guided. The success of the electric automatic fire-alarm for the first time demonstrated that electricity, when intelligently handled, was an agency which might be depended upon, as implicitly as heat or gravitation, to do its appointed work. A mere catalogue of Farmer's inventions and investigations for the next twenty years would fill pages; some of the most important of the former are the automatic repeater and the double-current system of duplex transmission, each of which now forms an indispensable part of the equipment of all the principal telegraphic systems of the world; the automatic printing telegraph, which modern Wall Street knows and reverences as the "ticker"; the automatic regulator for incandescent lighting systems; and, most important of all, the auto-exciting dynamo-electric machine. In this last, Siemens, Wheatstone, and Varley were independent and nearly contemporaneous inventors, but it is certain that the earliest written description of such an apparatus was contained in a letter written by Farmer to a distinguished English electrician. Notwithstanding the benefits which his inventions and discoveries conferred upon the world, the story of the first fifty years of Farmer's life is one of almost incessant struggle against poverty, sickness, and discouragement. He was literally one of those men who have no time to stop to make money. In 1872 he was made pro-

fessor of electrical science in the United States Naval Torpedo Station at Newport, a position most congenial to his tastes, and one in which he rendered the government most valuable service, until his increasing infirmities compelled his resignation in 1881. Since that time he has lived in comparative retirement, having been confined to his chair by a paralytic affection. To Professor Farmer, perhaps more than to any other man, may be traced the origin of the influences which have placed the United States at the head of the nations of the world in the originality, the diversity, and the extent of its industrial applications of electricity.

IF the true history of the art of illumination by electricity is ever written, the extent and value of the pioneer work of Professor Farmer in that field should receive the recognition to which it is justly entitled. He foresaw as early as 1858 that electricity was certain to become the illuminant of the future, and that for subdivision and domestic lighting incandescence was the only promising method. In that year he experimented with platinum and iridium burners, and ascertained the law governing the relation between heat, light, and current, which showed him that the efficiency of the lamp increased in an enormous ratio as it approached the fusing point. He was taught by this circumstance to make his lamps of equal resistance, to arrange them in multiple arc, and to automatically regulate the current at the common source of supply, and not at each individual lamp. During the month of July, 1859, he illuminated the parlor of his house at Salem, Mass., by lamps of incandescent platinum, to the admiration of all who saw it. Appreciating the fact that the most formidable obstacle to the introduction of electric lighting was the cost of electricity, as then derived from the voltaic battery, he devoted himself assiduously to the perfection of the thermo-battery, in which electricity is derived from the direct combustion of gas or coal, hoping to find in this direction the solution of his problem. In this line of research he met with some measure of success, but he ultimately concluded that a more promising source of cheap and abundant electricity was to be looked for in the magneto-machine. In 1866 his researches in this direction found rich fruitage in the discovery of the principle of the self-exciting dynamo-electric machine, to-day in use throughout the world as almost the sole means of producing electricity for all industrial purposes. He then returned to the problem of electrical distribution, and by 1868 had succeeded in operating 40 incandescent lamps in multiple arc, with absolute automatic regulation at the common source of supply, and in lighting a private residence in Cambridge, Mass., in quite a satisfactory manner. Iridium was found by him to possess the electrical properties necessary for a successful burner, but it was impossible to procure the metal in an available form. If the generating, regulating, and distributing apparatus of Moses G. Farmer and the vacuum carbon lamp of Henry Goebel had chanced to have been brought together, it is quite possible that we might have lighted our houses by incandescent lamps twenty years earlier than we did. All this should not and does not detract from the credit justly due to those to whom we are actually indebted for the electric-lighting system of to-day, but nothing can be more unjust than for us to refuse a generous recognition to the labors of the pioneers, in the absence of which the successes of later years would have beeen impossible of achievement.

THE curious visitor will find some interesting relics of Professor Farmer's pioneer work in the World's Columbian Exposition; among other things, the armature of his first dynamo-electric generator, constructed in 1866, the only portion of the machine rescued from a disastrous fire which occurred in May, 1868, and the original mantel of his house in Salem, to which were affixed the incandescent lamps of 1859. The lamps themselves have also been reproduced, as accurately as possible, under the personal direction of Professor Farmer, and the whole forms a valuable, though meager, historical exhibit.

THE attempt of parties interested in the promotion of electric traction by storage-batteries, to obtain authority from the Massachusetts legislature to run their cars over a portion of the lines of the West End railway, now operated by the trolley system, has proved unsuccessful. It came out, in the course of a discussion before the committee, that on the Milford and Hopedale line, which has been extensively cited as a successful example of storage battery traction, the figures returned by the railway to the railroad commissioners show that the operating expenses for last year were approximately 37 cents per car-mile, which, from a commercial point of view, cannot be regarded as particularly encouraging.

THE possibilities in the way of the economical distribution of power by electricity, which have been demonstrated by the continued successful operation of a number of large enterprises of the kind, are giving a renewed impetus to the construction of hydraulic works of great magnitude. One of the most interesting of these is the great dam across the Colorado, just above Austin, Texas, the completion of which has recently been celebrated. The dam is of masonry, 1125 feet long, and raises the water sixty feet above its original level. The flow of water is said to be from 200,000 to 250,000 cubic feet per second. It is designed to utilize the power for a pumping station, various factories and mills, together with a system of electrical distribution which will make cheap light and power available anywhere within a radius of several miles.

IN a paper read before the Royal Institution, Dr. John Hopkinson presents some additional figures and facts respecting the operation of the South London Electric railway. He gives the train mileage as 36,000 per month, and the number of passengers as 553,000. In an itemized statement, the cost of operation is divided into two parts, station-working and locomotive-working, both of which include wages and repairs. The former comes out equivalent to 9.18 cents, and the latter 13.80 cents per train mile. The full train load is only 100 passengers, and the average speed between stations is 13.5 miles per hour. From the results above given, Dr. Hopkinson computes that the cost of steam-traction per ton-mile of train is only about one-half that of electric traction, but, as electricity is practically used only for passenger traffic, the proper basis of comparison is the cost per passenger carried one mile, and in such a comparison electricity shows to much more advantage, because the trains can be divided into smaller units and run at more frequent intervals without material increase of expense. The appropriate sphere of electric traction, therefore, in Dr. Hopkinson's opinion, is not for trunk-lines, but for metropolitan and suburban service requiring accommodations at frequent intervals, and for secondary and branch lines where water-power is available.

AN electric street railway is now in successful operation in Bangkok, Siam, the rolling-stock and station machinery of which are entirely of American manufacture.

AN enterprising person in an eastern city, of the shopkeeping persuasion, proclaims that he will pay $10,000 to any person who will discover or invent, patent, and transfer to him, a practical device for propelling bicycles by electricity. He intimates that the storage-battery is probably not the thing. We drop this word of caution to aspiring inventors: When you have invented a successful device of this kind, do not permit yourself to be tempted for one moment by the glittering bagatelle of a ten thousand-dollar prize. Remember that 200,000 bicycles are sold every year. However, we think the shopkeeper runs small risk in making the offer, and might just as well make the amount $100,000 while he is about it.

THE teredo-worm is doing an immense amount of damage of late years to submarine-cable property. Even the heavy iron armor heretofore used on shallow-water cables has proved to be an insuffi-

cient protection. Within the past two or three years the worm has made its appearance in English waters, and large sections of the concrete of the Plymouth breakwater are said to have been completely honeycombed by the operations of this subaqueous pest. For this reason the new telephone cable just laid between Scotland and Ireland has been provided with a sheathing of brass, which experience has thus far shown the teredo does not attack.

THE results of a series of elaborate experiments made by the well-known electrician, Dr. A. E. Kennely, assisted by Dr. Frederick Peterson, demonstrate that the human organism is not affected in the slightest degree by the most powerful magnetic field capable of being produced by the resources of modern science, or, in other words, that magnetism is absolutely inappreciable to our senses. But as magnetism may and does convey dynamic energy with as much facility as electricity or heat, the paradoxical result follows that it is possible to transmit enough mechanical energy directly through the substance of a man's brain to operate a fair-sized motor, without producing the slightest appreciable effect upon him, either physical or mental. It has been claimed in times past, however, that there are certain persons who possess a so-called "magnetic sense." It is an interesting question whether or not there is any real foundation for this assumption.

ALTHOUGH the British public were very slow in taking up domestic illumination by electricity, surprising progress has been made since matters fairly got started. It is stated on the authority of Professor Ayrton that by the end of the current year a sum of money equivalent to $25,000,000 will have been expended in providing for the supply of electric current from the public mains in that kingdom exclusive of the cost to the consumers of the interior wiring and fittings. The whole number of incandescent lamps in Great Britain is stated to be equivalent to about 750,000 8 candle-power lamps. The number of lamps on the direct and on the alternating systems respectively are not far from equal; the direct system is, however, ahead at the present time. Storage-batteries have been much used, but it is evident that the present tendency is to discard them, so far as central station work is concerned, and to approximate towards American practice in details of distribution. An aggregate of about 100,000 horse-power of dynamos and motors have been manufactured in Great Britain during three years past.

AN ingenious automatic switch is now applied to the electric lamps in the guests' room in a hotel, whereby the locking of the room-door from the outside (but not from the inside) turns off the lights. Many travelers, it seems, doubtless with the philanthropic idea of helping the business of the local electric-lighting company, are accustomed to leave the lamps burning at full head when they vacate their rooms.

PROBABLY the most extensive electrical outfit in the world, employed solely for mining operations, is that of the Calumet and Hecla Company in the Lake Superior region. The plant has been some two years in course of construction, and comprises nearly every known form of electrical apparatus. There is among other things a complete telephone exchange, connected with which are many miles of telephone and telegraph lines, both above and below ground. Both alternating and direct currents are used for illumination, with voltages ranging from 52 to 1000. Large numbers of pumps, cranes, hoists, etc., are operated with electricity with great facility and economy. The safety and flexibility of electricity seem to render it almost an ideal agency for applying power in the varied and difficult operations connected with the mining industries.

ONE of the most interesting and instructive exhibits at the World's Columbian Exposition is that of machinery and appliances for electric welding. One machine, designed for welding large pipes, requires to operate it an electric current of

80,000 watts, equivalent to more than 100 horse-power. It will almost instantly weld the ends of an iron pipe six inches in diameter. Specimens of railway-track construction are shown in which the chairs are welded directly to the rail, also a three-way crossing in which there are six different welds, none of them less than twelve square inches in cross-section. There is shown a railroad crossing of rolled steel, all welded together so as to form a solid piece. The largest electrieal weld ever made, having a section of forty-eight square inches, also forms part of this remarkable exhibit.

THERE is an Electrical Light Association in Japan, which has issued a volume of its proceedings in the native language. It appears that 20 central stations are now in operation in that country, and the installation of others is rapidly going on. As a precaution against the effects of earthquakes, the machinery is invariably placed entirely upon the ground floor of the stations.

A SMALL incandescent lamp, about the size of a pea, is found extremely useful in the diagnosis of certain diseases. Placed in the cavity of the mouth, it illuminates the face from the interior, and makes it possible to see all the muscles and blood-vessels with the utmost distinctness. By attaching the lamp to a tube it can even be lowered into the stomach, the current turned on, and an examination made from the exterior.

THE Weehawken tunnel of the West Shore railroad (in New Jersey), which is 4200 feet in length, has been fitted with a novel block-signal system, consisting of a line of incandescent electric lamps about 300 feet apart and placed on a level with the eye of the engine-driver. When the lamps are all alight, it is an indication of safety; each train passing through extinguishes the lamps for a distance of 1100 feet in its rear, a result which is automatically effected by an electrically connected track-circuit, whereby the lamps are kept under the continuous control of the train. The operators in the signal-towers at each end of the tunnel can also extinguish the lights in any section of the tunnel if occasion requires. This system appears to embody a number of exceedingly valuable features, and, if successful in practice, cannot but increase the traffic capacity of a long tunnel largely beyond that which is possible by the methods of signalling heretofore in use.

THE International Electrical Congress of the World's Columbian Exposition will be held during the week beginning August 21, 1893. A large number of distinguished foreign electricians have announced their probable attendance. The program has been issued, and the schedule of subjects to be discussed indicates that the work of the Congress is likely to be of great permanent value to the profession. Three popular lectures are announced to be given during the session of the Congress by eminent electrical authorities.

AN immense electrolytic copper refinery has been started at Great Falls, Montana, by a Boston company. It comprises 288 depositing vats capable of containing at one time 1,600,000 pounds of pig copper anodes, and has a capacity of 1,200,000 pounds of pure electrolytic copper per month. The plant is run by water-power, situated at a distance of 2100 feet from the works. The current is supplied by two dynamos, of 165 kilowatts capacity each. The total cost of the plant, exclusive of real-estate, is said to have been over $350,000. The metal refined contains a large percentage of silver, all of which will be saved by the electrolytic process.

THE witnesses who have given testimony in the recent investigation respecting the efficiency of the Boston fire-department seem to be unanimous in the opinion that the operations of the firemen at large fires have often been greatly impeded by the lines of overhead electric wires in the streets. The chief of the department observed that the telegraph wires have caused the firemen far more trouble than street-railway wires.

MECHANICS

Conducted by Leicester Allen.

THE steam-fitting work in the power plant of the World's Columbian Exposition probably ranks as the highest manifestation of the art to be found in the world. Not only on account of its unprecedented magnitude, but because of the workmanship, it is in itself a grand exhibit. Besides, it represents all that is best and most modern in the art, which, since the era of increased pressures began, has been found competent to meet every new requirement, and has advanced accordingly.

THE electro-plating of iron with aluminum by a direct process has not been accomplished; but, by first coating either cast- or wrought-iron with copper, aluminum may be deposited upon the copper, and the results, according to *The Metal Worker*, are good. The following description of the process, as carried out at the works of the Tacony Iron and Metal Company in Philadelphia, is extracted from the journal named:

Six long and deep tanks are used. The article to be plated (in this case a heavy iron column) is placed in tank No. 1, containing a solution of caustic soda, in which it remains 24 hours to clean it of grease. Thence the casting is removed to tank No. 2, where it undergoes pickling for the removal of scale and oxide, remaining 24 hours more. It is then thoroughly cleaned by hand, with steel scratch brushes, preparatory to being placed for a further period of 24 hours in tank No. 3, where it receives a primary deposit of copper. In the fourth tank, to which it is then removed, it receives a very heavy electro deposit of copper, remaining in this tank for 72 hours. This prepares the casting for the reception of its aluminum coating, which is imparted to it in tank No. 5. Here it also rests for 72 hours, an even coating of $\frac{1}{16}$ inch of aluminum being deposited. The last tank to which the plating casting is then removed contains hot water, in which the casting is allowed to remain just long enough to be thoroughly washed. The process is then complete, and the article emerges with a "matt" or dead-white finish of aluminum, which can be burnished at will. The lengthy process detailed above was found necessary for the heavy work done at Tacony, but the principle stands good for smaller castings also, of which a number of specimens have been turned out from those works.

IN a recent number of this Magazine mention was made in this department of the recent great extension of the range of artificial temperatures, both positive and negative, and its possible and probable effect upon the future of the mechanic arts, especially those in which metals are the materials worked. A still further extension of the range has since been announced, the most notable having been effected by the Belgian scientists, Messrs. Lagrange and Hoho, who have succeeded in producing, as they are said to aver, a temperature as high as 8000° Celsius (14432° F.) The method employed by them is extremely simple, and, when considered with reference to the results obtained, would, to most people, appear utterly inadequate. This view was held in the German patent-office, where the application of the inventors for a patent resulted in a demand that they should exhibit the method to a scientific expert before the validity of their claims would be admitted, and this is stated to have resulted in the full confirmation of their stated results.

THE method may be broadly stated to be the passage of a current of electricity through the substance to be heated while the substance—or that part of it which it is desired to heat—is immersed in or surrounded by a film of hydrogen gas, the latter being produced by the electric current simultaneously with the heating of the substance. A vessel of porcelain is lined with lead, and placed in an electric circuit by connecting it with a conductor in such manner that, when the apparatus is at work, it is positive as regards the substance to be heated. The latter is held by tongs with insulated handles, the tongs

also being connected so as to form a part of the circuit. Then water, to which a little acid has been added, is placed in the vessel, and the electric circuit is completed by the operator, who, grasping the handles of the insulated tongs, dips the substance, or that part of it which he desires to heat, in the water. The circuit being thus completed, a thin stratum of water is immediately decomposed, the electro-negative oxygen collecting on the electro-positive lead lining of the vessel, while the electro-positive hydrogen collects around the substance to be heated, insulating this from the water by a thin film, which resists the passage of the current to the surrounding water from the substance to be heated so remarkably that the latter is heated to incandescence in an almost incredibly short space of time. Iron is thus brought to a welding heat in a time very much shorter than that required in a forge, and its surface is perfectly clean and in the very best condition for welding. What seems almost magical in this process is the fact that, while the water in close proximity to the heated metal boils immediately when the latter is plunged in it, the mass of the water in the vessel is hardly more than warmed while bringing the metal to a white heat, even though the latter may contain a considerable weight.

MANY are disposed to receive with doubt the statement that on May 9 the locomotive No. 999 of the New York Central railroad ran at the speed of 100 miles an hour, or that on a subsequent date she ran a single mile in 32 seconds, which is at the rate of 112 miles per hour. The statements have been widely accepted and published in the daily press, but those who are competent to judge of such matters are by no means unanimous in giving credence to what been said of this very remarkable performance; for whether the speed claimed to have been made was really achieved or not, the performance was remarkable, as being probably the highest rate of running ever made by a locomotive in a trial of speed. The *American Machinist* at first was inclined to accept the results as stated, but since has seen reason to revoke its opinion expressed at the time, and in its issue of June 1 says that "the information as to this seemed at that writing to be authentic, but since then a good deal of doubt, in which we share, has been thrown on the stated performance. We were misinformed as to the use of the speed-indicator on the engine, for one thing, and a careful consideration of all the conditions make the speed given improbable."

The journal quoted also very sensibly remarks that "fast time in little spurts, or in special instances, is not of much importance. The question that interests the traveling public is how much the time between distant points, as New York and Buffalo, or Chicago, can be shortened."

FURTHER exemplifying the small value of brief exceptional speeds, the *American Machinist* cites an example of a stationary engine with a piston seven inches in diameter that a few years ago was run at a speed of 1300 revolutions per minute, and ran very smoothly, but adds in substance that no one is now building stationary engines to run at that speed. It is presumed that the editor of the paper quoted refers to a reciprocating engine that was built in the now defunct Delamater Iron Works in New York, from designs made by the late John Ericsson. This engine, the only one of the kind known to the editor of this department, was used for running a dynamo that supplied current for electric lights in the foundry. It gave no more trouble than has often been met with in running engines designed for much lower speeds; and if, for any purpose, an engine running at such a speed was not only desirable but essential, there would be plenty of engineers now living who would undertake to supply them, without fear that it would be impracticable to regularly run engines at the desired speed. Whenever there really arises a commercial demand for railway travel at 100 miles per hour, sufficient to warrant the expenditure of time, money, brain, and material necessary to attain it, the demand will be met.

AN announcement of a method of hard-

ening and tempering steel by electricity opens a new lead in mechanical construction, to-wit: localized hardening of surfaces. The method has been originated by MM. Lagrange and Hoho, and is described in *Comptes Rendus*; but the modus operandi is a more appropriate subject for the electrician than the mechanic, as its description involves electrical laws and principles. It will be sufficient here to name the most remarkable of the results, which is the formation of a thin hardened film or skin over the entire outer surface of a piece of steel while the interior remains soft. It is said any degree of hardness in such a film may be attained. New possibilities in the application of such a process will at once suggest themselves to mechanics.

IT daily becomes more evident that we are on the eve of many radical changes in mechanical arts due to new applications of electricity. Some months ago the application of electric welding to pipe-fitting, as a means of avoiding the use of cast-iron fittings, at least partially, was suggested in this department as a field upon which some enterprising electric engineer might enter with a fair prospect of reward. This field is more and more becoming ready for such an innovation, through strong competition in the manufacture of pipe-fittings, the effort to cheapen the cost of fittings having resulted in placing on the market many inferior qualities. It is often difficult to obtain reliable fittings, and steam-fitters throughout the country are frequently embarrassed by discovering defects that can only become apparent to them after the erection of work, thus necessitating doing the work, or a part of it, over again, perhaps only to find that the fittings substituted for those at first found wanting are again defective, and that, while stopping primitive leaks, new ones have been introduced.

AT this writing there seems to be a good prospect that a series of mechanical tests, recommended by the American Society of Mechanical Engineers, will be made the basis of awards at the World's Columbian Exposition. There appears to be almost a unanimous expression of opinion favorable to the carrying out of these tests under the direction of recognized experts, not only on the part of engineers generally, but also among the exhibitors. Apart from any commercial interest that may influence the views of exhibitors, it is seen that such a series of tests, performed by able specialists who have the public confidence, must result in the publication of reports whose instructive value can scarcely be over-estimated.

THE trial trip of the new United States armored cruiser *New York*, which was made on May 22, has been, perhaps, the greatest event in marine engineering since the matter for the last number of this Magazine was in press. There is no doubt that this vessel represents all that is best in naval construction and armament, and she is probably entitled to rank among the fastest war-ships, if not as the fastest afloat. At any rate, the speed developed on the trial trip, 21 knots an hour, is a gait very hard to overtake or to run away from. The excellent performance of the engines, still new, through so severe a test, prolonged for a period of four hours, shows a superior character both in design and construction. In short, all the machinery and the outfit are of most approved kinds. Among the machinery the air-pumps are worthy of mention as being of special design and proving remarkably efficient. It was, doubtless, owing in some measure to the excellent vacuum maintained by the air-pumps that the power of the engines proved equal to the demands made upon them during the trial. These pumps as well as the entire outfit of pumps used on the ship were supplied by the George F. Blake Manufacturing Company, of New York. It would be unadvisable to occupy space here with such a meager description of the details of the engines as could be given in the space available. The result of the trial has not only demonstrated the excellence of the ship in all material points, but it will entitle the eminent constructors to a very handsome premium, to which, in view of the published results,

the country at large will think them well entitled.

LOCOMOTIVE engines were run successfully at high speeds at a time when it was generally thought entirely impracticable to run stationary engines of equal size at similar speeds. No longer ago than 1876 the writer had an argument with an engineer of high attainments and considerable achievement, who took the ground that for some unknown reason a locomotive could make more turns in a given time than any stationary engine that had been or could be built, without giving trouble by heated bearings, etc. The position taken seemed absurd, when the difference in the working conditions was considered, which, from an engineering standpoint, seem far more favorable to the stationary engine running on a solid foundation in a cleanly power-house, or engine-room, always on a level base, and in perfect alignment, whereas the locomotive is continually surging from side to side, changing the level of its base, and running often through clouds of dust, difficult to exclude wholly from bearings. The fact remains that for many years locomotive engines led the van in the matter of high-speed running. The reason appears to have been that the high speed was so imperatively demanded that the necessary efforts to get it were put forth. So far in the history of mechanical progress sufficient demand has secured sufficient supply, and there is no reason to believe that it will be otherwise in the future.

THE creosoting of railway-cars bodily after they are built is one of the latest attempted innovations. The experiment, said to have been entirely successful, has been carried on in England, and has been described, more at length than it can be in this department, in *Industries* (London). A large cylindrical chamber of boiler-iron is employed, and this is placed on its side, in which position the car to be creosoted may be run into it from a track arranged so that it meets a short track laid in the lower part of the cylinder. The open end through which the car has been run in is then closed by a swinging door which is fitted to a flange, to which, when closed, the margin of the door is clamped. Under the cylindrical chambers are placed receptacles for the antiseptic fluid, and by pumping out the air from the chamber the liquid is forced, under atmospheric pressure, up from the reservoirs into the creosoting chamber. Glass gages indicate the height of the liquid in the chamber. A pressure gage is connected with the cylinder, the latter being constructed to withstand safely a pressure of 100 pounds to the square inch; and a safety valve, connected with an air-space in the upper part of the apparatus, is used to limit the pressure to that named. Under this pressure the liquid is forced into the pores of the wood, and the car is allowed to remain several hours in the chamber to thoroughly complete the process. The apparatus is so arranged that the droppings of liquid, when the car is taken out, run back into the lower receptacles. It is easily seen that a large saving of the antiseptic fluid results from the treatment of the completed structure rather than the lumber before it is worked, as, in the latter case, all the waste in construction will represent a proportional waste of the liquid. Whether this saving will compensate for the increased cost of apparatus and manipulation sufficiently to render the treatment of the completed cars profitable is a yet unanswered question.

A NEW drawing-pen which is claimed to contain the promise and potency of great convenience in the drawing-rooms of mechanical establishments has been invented, and is now placed on the market by a firm in Leeds, England. It appears to have occurred to some one that the convenience of the now extensively used fountain-pen in ordinary writing might be attained analogously in a fountain-drawing-pen. The fountain consists of a cylinder containing the ink and forming the handle of the pen. A small tube reaches from the hollow handle down into the space between the nibs of the pen, which are of the same form as the common ruling pen. To supply the nibs with

ink the latter is forced through the tube by pressure upon a small plunger fitted to work in the cavity of the handle, which is operated whenever the ink is wanted. The ink is drawn into the hollow handle exactly as water is drawn into the barrel of a syringe by the reverse action of the plunger, and when it is filled it is said to contain ink for several hours' use.

THAT there are dialects in technology, as well as in the ordinary language of business and conversation, any one may convince himself who will take the trouble to compare the various vocabularies of mechanical terms and phrases in use by different trades in different countries speaking the same language, and even in different parts of one country. The number of such terms is constantly increasing, keeping pace with the introduction of new machinery and processes. One difficulty Americans meet in reading works upon industrial subjects published in England is the occurrence of such terms without explanation either expressly, or by implication in the context; yet these terms, when their definition is found, often turn out to mean something quite well known to the reader, who has been accustomed to hear it called by another name. If some author would supply a complete dictionary of technical English terms, taking pains to collect all local synonyms, with copious cross-references, up to date, it would be very useful.

THE effort to secure an increase of production without corresponding increase of cost is commendable in and of itself, and it has resulted in a much larger output, measured in quantity, from most modern establishments. But to what can the notable deterioration in the quality of manufactured articles be attributed, if not to the effort to compete by cheapening products regardless of quality? A very large proportion of all lines of goods now placed on the market are inferior to articles of their kind as made twenty, or even ten, years ago. There must be some limit to the extent to which cheapening by deterioration and adulteration can be carried. It is true that manufacturers may justly excuse themselves by the assertion that they must make what the public demands, and that more and more the public demands cheaper articles, and is willing to put up with inferiority if by so doing first cost can be reduced. It is hard to find any answer to this argument. The manufacturers make out a good case as between themselves and the majority of their customers. The desire for outside display, even at the sacrifice of intrinsic worth, that pervades modern society is at the root of this as it is of many other evils. When the cheap and nasty ceases to be sought by purchasers, it will no longer be placed on the market. The misfortune is that manufacturers have contrived to finish things that are inferior in such a way that they simulate in outside appearance that which is really good. Those who would continue to make really good articles may, perhaps, initiate a reform by adopting a plainer style of finish, such that its imitation cannot disguise defects.

OF that class of mechanical drawings commonly classed in the category of sketches, or such as are not drawn to an exact scale, and in which the guide to proportions of parts is, therefore, solely such dimensions as are given in figures by draftsmen, Mr. Walter B. Snow has made useful suggestions, which he has communicated to the *American Machinist*. He recommends the use of letter-size paper and an aniline pencil for making the drawings, and their duplication by copying, in the same way as letters are copied. Four or five copies can thus be made, and one of them mounted on cardboard may be used in the shop, while the original can be sent to a customer to guide him in setting up or applying the thing ordered. Another copy may be retained for the office records. In "hurry jobs" a great deal of time can be thus saved that would be required for blue printing, especially in a cloudy and dark day. A special series of copying books could be used for these sketches, which, as Mr. Snow points out, would be particularly convenient in the suggestions and preliminary sketches that so often pass before an order results.

ARCHITECTURE.

Conducted by Barr Ferree.

THE uselessness of architectural competitions never had a finer illustration than in that which the Brooklyn Institute of Arts and Sciences lately set on foot for a new museum building in Prospect Park, Brooklyn, and which has now come to an end. This competition was more than usually remarkable in several ways. It was instituted, in the first place, at the instigation of a body of architects, who formally set their approval upon the competitive method as the very best way of obtaining the very best building. How far they were right remains to be seen, for a museum building is necessarily of so complex a nature that only after it has been in use for some time and its capacity tested, as well as its adaptability, can its full success be measured. The competition was further peculiar in calling for the accommodation of an institution numbering practically some twenty-five or more distinct scientific and literary societies, all with their own collections and apparatus, and all needing distinctively individual rooms. The program was necessarily an extremely complicated one, and the competing architects must have had to devote many hours of study to it in order to prepare themselves for the task of design. This complexity was, of course, a circumstance over which none of them had any control, since it was an essential element of the problem; but, admitting this to be the case, the fact remains that only by an extraordinary distortion of the value of a competition could seven or eight architects—the final number in the competition—have been put down to study the long list of details. To comprehend the building aright one should have been a museum expert, which few architects pretend to be. But the professional judgment of those responsible for the competition was that their body included a number of museum experts, and the great trial began. A limited number of architects of the first rank were selected from the architectural members of the Institute, all of them, presumably, of equal capacity for carrying out the work, and any one of whom, it may further be surmised, would have been equally satisfactory and congenial to the Institute authorities. In due process of time it was found that the most eminent of the competitors was adjudged as having presented the most successful design, though the jury of experts, strangely enough, admitted that its chief merit was that it could be changed in any sort of way without entirely destroying it. There is little doubt that the same eminent firm that won this competition would have been selected to undertake the work if there had been no competition, and if eminence had been a desirable standard of value. The whole architectural profession, as well as the unsuccessful competitors, may well ask themselves, if such was the case, why should a competition have been held? The result was just what it would have been without the competition; wherefore its use?

THE most interesting feature of the Brooklyn museum competition—it cannot be called surprising, since it is just what might have been expected—has been the extent to which the work of the younger men exceeded that of the older. The three most notable designs submitted were shown by Mr. Albert E. Parfitt, Mr. Albert L. Brockway, and Messrs. Boring and Tilton, all young men, and all showing designs of more than ordinary merit. Mr. Brockway's design exhibited an exceedingly clever façade, that told, as well as any façade could, that it was the front of a museum. The plan, however, was not as well carried out as some of the others. In Messrs. Boring and Tilton's design the

opposite conditions prevailed, the plan being admirably studied while the façade was less satisfactory—to place it in comparison with a thoroughly good example—than Mr. Brockway's. The management of the roofs, while very Ecole, was labored, and the dome far from effective. Neither of these criticisms can be made of Mr. Parfitt's design, which was clearly the best of the seven submitted, and we see no reason at all why he should not have obtained the prize of the award. The plan was studied with great care and with the nicest perception of the uses to which the rooms and courts were to be put. Alone of all the plans it included a monumental staircase of magnificent proportions, which, while it interfered with a view from one end of the building to the other, was so admirably thought out and artistically planned as to more than compensate for the loss of a vista. The design of the façade was both effective and beautiful. The central feature was a triumphal arch, of fine proportions, buttressed by two sturdy pavilions. A colonnade twenty-eight feet high, introduced in the third story, formed the chief feature of the wings, which, in their turn, were buttressed at either end by broad piers of masonry. The whole design was dominated by a dome, of sufficient size to be well seen in perspective,—surely a most necessary requirement in a dome. Well balanced, duly proportioned to the duties assigned to each part, this design was, in our opinion, entitled to be placed first. It was a noble conception, admirably conceived and as admirably carried out. The author—who, by the way, is a young Brooklyn architect—may rest assured, however, that he has produced one of the most notable designs of the year, a work that he can always look back to with pride, and which, more than anything he has yet done, will be a good big stone in the foundation of a reputation that must grow largely every year.

IT is unquestionably the greatest misfortune of current architecture that the high office building was not invented in the sixteenth century. Had this been the case, we would not now be groping in the dark, each man trying his own individual ideas to the great discomfort of those who are daily forced to look at his work, and, in the lack of homogeneity which such procedure entails, to the lasting retardation of the art. If modern architects had precedents three hundred years old to help them in the design of their office buildings, most likely we should not only have better structures than we have now, but we should be saved the necessity of labelling structures Italian which are totally unlike anything in Italy, and whose chief Italian characteristics exist only in the mind of the designer or the draftsman. A few weeks ago the metropolitan newspapers seemed to be afflicted with a sort of architectural contagion, since panegyrics on the merits of a new office building for the Manhattan Life Insurance Company in New York appeared simultaneously in several of them. As an example of loose nomenclature and the methods employed in designing high structures this edifice is a very fair sample. From the sidewalk to the top of the dome is the astonishing distance of 317 feet. As the width of the building is but 67 feet, the advantages of the Italian renaissance, which, we are told, has been selected for the building,—and which by nature and by application was a style of architecture peculiarly adapted to width and broad surfaces,—are very far from being obvious. In the sixteen stories forming the central portion of the front no part is more than three stories high, the architect having diversified the scenery as he mounts skywards either by friezes or strings, or by wholly changing the character of the architecture. When to these horizontal changes are added a few vertical ones, and a dome and its supporting story are added, it is obvious, without the help of a picture, that a great many ideas, or attempts at ideas, are contained in this great front. The completion of this structure will be watched with interest because it is, in some respects, the most notable application of the New York horizontal-afraid-to-build-high, variegated style of designing high office buildings.

THE "practical politicians" who make up the body of the governing corporations in our seaboard cities will find fruitful subject for reflection—if the faculty has not been obscured through lack of practice—in the little book on Berlin written by James Pollard, Esq., chairman of the Edinburgh public health committee, and secretary of the Edinburgh chamber of commerce, and entitled "A Study in Municipal Government." Mr. Pollard set forth with the admirable intention of telling his fellow-townsmen how they managed things in a well-ordered city on the continent, and the result of his observations might well be studied by municipal managers in America. The great trouble with American municipal government is the lack of homogeneity in the growth of great cities. Each city starts out independently and on a better plan than any other, and yet with very little thought of profiting by the experiences of older ones. American politicians are apt to plume themselves on the advances they have made in their own departments, and some even go so far as to point with pride to the growth of their particular city. Yet with all our boasted progress the fact remains that the best governed cities, the most ably developed and thoroughly broadened municipalities, are the old cities of the new world, in which the necessity for new growth and complete change from the old have been so wholly recognized as to compel the introduction of a new order of affairs. Nothing of the sort is to be seen in even the most active communities in America. New York cannot annex other districts because local politicians interpose objections which have no foundation save their own selfishness. Boston is hemmed in with so-called rival municipalities that hug their civic privileges and imagined independence with absurd pretensions of might and power. Philadelphia has, in truth, added vastly to her territory and stands quite distinct among seaboard cities in this respect, but she is wanting in the metropolitan spirit and capability of development which alone would make this increase of territory valuable. In the west a different feeling may be noted, and this, as well as their more rapid rate of increase, tends to make our western cities more prosperous, as well as more modern, than our eastern.

FEW municipal officers in America would have taken the trouble to write a book on a foreign city, such as Mr. Pollard has done, and few—to our lasting disgrace—would have been capable of making the observations he has made. Yet it is only by the comparative study of municipalities, a critical noting of their peculiarities and characteristics, and an insight into their methods, that other cities can grow and keep pace with the times. The conditions of city life are so little appreciated by modern philosophers that the astonishing fact that the making of a modern city consists chiefly in undoing what has been done before is scarcely recognized in the books. Yet is the making of a modern city anything but this? Are we not continually taking up the pavements of city streets to put down something new, or remodeling our city plans, or taking down houses and shops that new ones may be erected on later and more improved plans? At least we think we do, though often the improvement is more theoretical than real. There is too much carelessness in American city-making, too much slipshod work, too little unity and singleness of purpose. Quite the contrary has been the case with Berlin, which, just after the close of the war of 1871, was one of the vilest and most unsanitary cities in Germany. The poor were confined to basements or top stories of tenements, to cellars, or similarly unhealthy places. As many as 4565 dwellings were without any fireplaces whatever, while 95,000 dwellings had only one room with a fire-place. Many other worse conditions existed, but this is sufficient to indicate the abominable condition of the city. The energy with which a single eminent man of science, Professor Virchow, devoted himself to the task of reformation has made Berlin one of the most admirably maintained cities in Europe, with a death-rate that has decreased from 30 to about 20 per 1000, and is expected to be further reduced. It

would require more space than can here be given to it to even briefly catalogue the changes and improvements necessary to produce this result, which was brought about, first of all, through the energy of an extremely able man, and, secondly, through the vigor with which the corporation applied itself to the work of reformation and cure. There was little "politics" in this work, but those most active in it have reared for themselves a monument that will last while there are tongues to tell of it or scribes to set it down in writing. The picture, as Mr. Pollard has drawn it, is an interesting and an impressive one. Would that the governing bodies in our American cities would feel called upon to follow the same path.

THE articles on architecture which appeared in *Scribner's Magazine* three years ago have just been collected in a book. This seems an unusual length of time to have elapsed, and it is a pity it was permitted, since, while the value of the text remains the same, the value of the illustrations as examples of current work has greatly diminished. Not that the houses they show are less beautiful,—when presented as illustrations of the beautiful,—but domestic architecture has progressed a good deal in the last three years, and the illustrations are, therefore, totally inadequate as helps to an opinion on current work, while the further fact that the date of the original appearance of these papers is not so much as hinted in the book is likely to lead forgetful readers astray. It was a further misfortune for the publishers to have announced the papers in the volume to be by "six eminent authors." Both words are, perhaps, of difficult definition, but a man can be an eminent architect without being in the least qualified to act as an eminent author, and the converse rule is equally true. Of the six contributors to the volume only one, Mr. Russell Sturgis, can rightly be called an eminent author, the others, including Mr. John W. Root, Mr. Bruce Price, Mr. Donald G. Mitchell, Mr. Samuel Parsons, Jr., and W. A. Linn, being, with the exception of Mr. Mitchell, better known for the work they have done in other fields than that of literature. Doubtless this looseness of speech—or should it be called looseness of advertising?—is a matter of no great consequence, but in a book of so serious an import as this it is a pity that everything connected with it should not be entirely in order. Further exception might be taken to the title. "Homes in City and Country" has a homelike, ordinary flavor suggestive of quiet domestic happiness, yet nearly all the contributors deal more with the ornamental and ceremonial aspects of a house than with its domestic possibilities and characteristics. Mr. Sturgis, for example, who presents an historical sketch—unhappily only too brief—of the development of the city house in the east, has very little to say concerning kitchens, cupboards, cellars, furnaces, heating, and the thousand and one details which go to make a home, though he is very much disturbed indeed if the butcher-boy happens to make his call while the mistress of the house is entertaining her guests, or should happen to deposit his meat-basket within a foot or two of or—horror of horrors!—perhaps upon the very doorstep which the sacred foot of a guest must pass in order to gain entrance. All of this is very instructive, and some of it not a little amusing, but surely a successful home—if that be the proper adjective—is not the most so because its owners can most freely yet ceremoniously entertain their guests.

With the exception of the historical part of Mr. Sturgis's paper the most interesting part of the book is the study of the city house in the west by the late John W. Root. As might be expected from one whose successes in life were gained in the west, Mr. Root is full of enthusiasm for the life there and its architecture. Eastern critics, perhaps, may not always be willing to give credence to the architectural revival in the west, but it unquestionably exists, just as it is unquestionably far in advance of any similar movement in the east. In some respects the west has had more to unlearn in architecture than the east. Its earliest development was full of horrors of every description, all of which

must be forgotten and destroyed before a permanent reform can be effected. This is already in fair way of being accomplished. The crudities and excrescences which, a few years ago, passed for architecture in the west are no longer to be seen, save in ancient examples. The inferior quality of this old work was so marked that not only has a new school now arisen, but the old work is so generally recognized as bad that it is destroyed to make room for better and purer work. And this is not only architecturally more interesting than the old, but it is of better workmanship and is destined to last, not only for its own inherent permanency of construction, but from its architectural grace and beauty. The west has a further advantage from the openness with which nearly all western cities are erected. The country house is the one form of architecture which American architects seem to have most clearly comprehended. And this not so much from the simplicity of the problem as from the frequency with which it is presented. The city house of the west, unlike its prototype of the east, is more a suburban residence than the solid stern structure built in rows in the east. There are freer opportunities for architectural treatment, and with less confined limitations the architect manages on this account to produce a much more pleasing result than with solid blocks of dwellings, each of the size and apparently all designed for the same occupant. The suburban and country house is further treated by Mr. Bruce Price, Mr. Donald G. Mitchell, and Mr. Samuel Parsons, Jr., thus occupying much the larger part of the book. The concluding paper by Mr. Linn on "Building and Loan Associations" is quite different in subject matter than the other papers in the volume, though it treats more of the home than they do.

THE bestowal of the Royal gold medal of the Royal Institute of British Architects upon Mr. Richard Morris Hunt, of New York, which took place in London during the past month, was an event of unusual significance. Not only was Mr. Hunt personally honored in being given this decoration, but it was at the same time a high tribute to American architects and American architecture by the leading professional body of Great Britain. American architecture has been so long looked upon by reputable English architects as a hybrid distorted product that this professional courtesy is of the utmost significance in indicating the solid foundation of merit which exists in the art in this country. The presentation of the medal shows, therefore, that not only has American architecture progressed to a point where it can be profitably and honorably compared with the best of older countries, but that the most exclusive people, architecturally, are willing and glad to admit this fact. No greater compliment has ever been paid to American architecture than in the ceremony of which Mr. Hunt was the chief figure. He himself does not need our words of praise to do him honor. His long life has been devoted to the noblest art in the noblest manner. He stands for all that is good and truthful in American architecture, and when this has been said there is little more that need be added. No man has more firmly impressed his personality upon the architecture of this country than has Mr. Hunt. Richardson did, indeed, inaugurate a school that has made itself felt for years after his death. But the fundamental element of Richardson's art was exaggeration and a venturing forth into new fields. Mr. Hunt's influence, on the contrary, has been towards restraint. Not a single example of his work is characterized by that striving after effects which Richardson himself often fell into and which his followers exaggerated to an intolerable degree. There is, in truth, no need to compare the two men; each had his work to do and each did it to the fullest of his ability. Fortunately for architecture in this country Mr. Hunt's work is not yet done.

MINING AND METALLURGY.

Conducted by Albert Williams, Jr.

ANNUAL meetings of English mining companies, as reported in the English technical journals, are a constant source of wonderment to American readers. They also have some features that are well worthy of imitation in the United States, where these meetings are perfunctory performances, the shareholders being mostly represented by proxies, and the business rushed through on a cut-and-dried system, the few persons in attendance voting in or out the directory and approving or disapproving the policy of the management, solely in accordance with the proportion of shares represented on one side or the other, which balance of power has been ascertained in advance. Practically the minority in American companies have no say at all in these meetings. If they don't like the way in which the company's affairs are managed, they stay away from the meeting, and, if the case is urgent, rely on the dubious interposition of the courts for redress. In the annual meetings of English mining companies, according to the reports, all is different, and sometimes amusing. There is generally a large attendance of the small shareholders; there is an M. P., a distinguished general or admiral, or at least a titled figurehead of some sort, in the chair, who reads a minute and lengthy statement of the operations of the company for the year, and at the close of each of his paragraphs pauses to allow time for the British reporter to patriotically add in parentheses, "hear, hear," "applause," or "loud applause." But there is a serious side to these formalities, verbosities, and long-windedness. The audience is large and deeply interested. Questions are asked and answered; the freest debate is allowed on doubtful points; the listeners come to the meeting with a desire to find out the true status of their investments, and are by no means backward in pushing their interrogatories. As a rule the shareholders are (like their cousins in the Eastern States of this country) profoundly ignorant of the technical phases of mining; but "they want to know," as they certainly have a right to demand, what is being done with their property and their money. This jealous watching of interests is a potent, though often misdirected, factor. But it would be well for American companies if the same amount of interest could be aroused.

LATELY there was held in London the annual meeting of a company operating mines in Montana. The chairman (or, as we should call him here, the president of the board of directors) read the reports of the superintendent, the treasurer, etc., and as usual made a speech. The company had made money, but there were no dividends. It seemed that the management rather discredited the existing properties of the company, and proposed to buy up new claims to provide an ore-supply for their mill. Then there was a commotion. It was shown that the chairman (who had been liberally paid for a trip to and examination of the property) was, with other directors, interested directly in the locations which it was proposed to take up. At this stage of the proceedings American shareholders would have paused to count up their strength. Not so the Britishers. The resignation of the chairman and a part of the directory was promptly demanded and acceded to; new officers were voted in; and the meeting proceeded, somewhat irregularly, and perhaps illegally, but very determinedly, to establish things on a new basis, very much like that ensuing on a cabinet downfall after a vote of confidence has been lost. What the merits of the case were in this instance we have no means of knowing. But there is a lesson in it.

As is usual in international exhibitions, there is now the customary fault-finding from various sources about the mineral display at the World's Fair. Considerable local jealousy has been aroused, State aganst State and Territory against Territory, even county against county and district against district. But all this feeling has acted as a stimulus in inciting each part of the country, and each foreign country, to make a good showing. It is not possible to please everybody. Ninety-nine people out of a hundred who visit the World's Columbian Exposition are better pleased with the showy, catchy display of fancy ores and minerals than with the scientific features. The few experts demand something more solid,—systematic collections of measurable value. It is hard to satisfy both classes, and, until some one has adjudicated the vexed question of what the great Fair is for, after all, it is the best policy to give all visitors their choice. At present there is a current of adverse criticism, but it is somewhat mixed and contradictory. The mayor of Denver, for example, says that the Colorado collection is too "scientific." Probably he wants more silver and silver-plated statues, more pyramids of showy ore, more gilded bricks and obelisks, and what the *Mining Industry* (Denver) calls "a pagoda, Joss-house, or imitation palace," to cover it all in. The majority indeed seem to favor the dime-museum idea. On the other hand, the professional miners and metallurgists would like to see a systematic arrangement that would convey some information of what is being done and what the resources are in various parts of this and other countries. So far as we can make out, without personal inspection as yet, this feature—the one which will be prominent in the minds of thoughtful visitors—has been mostly disregarded, though a few exceptions are described. There has been no lack of money to collect and exhibit the mineral treasures of the mining States, and there has been plenty of time to organize. Of course there have been mistakes in the selection of men and methods, and a considerable waste of public money. It is rather too late to attempt to correct former errors now, though some of the States are still trying to get together further supplemental collections, for which the floor space of the mines building is probably inadequate. Colorado and California have been especially disappointed in their exhibits, though abundant means were provided and there was plenty of public spirit among the miners and metallurgists.

In spite of all failures and disappointments, in spite too of a disagreeable element of vulgarity and tawdriness, the mining exhibit in its entirety is certainly a great one.

A MODEL exhibit at Chicago is that of the Bethlehem steel works in the Manufactures building. The catalogue shows only about a dozen pieces, but they represent the various stages of production of gun and armor-plate forgings in an intelligible and instructive manner—just as they look in the works, without adventitious aids from finish and decoration—and two steam-hammers as illustrative of the tools used in steel metallurgy. Exhibits like this, of which there are other examples, are of real educational utility, and there are always enough sensible people to appreciate them.

COMPARISONS may be odious, but one feels impelled to enter a mild protest against an expression used by Mr. Thomas E. Brown, Jr., in his admirable paper on "The American Passenger Elevator" in the June ENGINEERING MAGAZINE, referring to "the crude mechanisms for hoisting, such as are used in mine-shafts." Something should be allowed for difference in conditions. Modern practice demands high speeds in lowering and hoisting in deep vertical shafts, these speeds often ranging from 1000 to 3000 feet per minute, and, though it is usual to run the mine-cages at lower speeds when carrying men than when loaded with coal-, ore-, and rock-cars or empty, still in the big mines they move with a velocity something like that of a railway train. It is not possible to keep the shaft timbers and guides in perfect alignment; the additional great

dead weight of cable in deep shafts has to be considered; the underground loading and unloading have to be done with the disadvantage of poor light, mechanical or electrical uncertainties as to signalling; often dripping water, vitiated air, steam and heat to disconcert the men; and more important than all, it is economically impracticable to introduce all the refinements which are possible in the construction of passenger lifts at the surface. Yet, notwithstanding all the disadvantages of conditions, shaft accidents in mines where cages are used have been reduced to very low percentages. There is a record of 6,000,000 individual trips of men up and down 1200 feet in an English colliery at the usual speeds without the slightest accident, and doubtless many similar records could be produced. A fatality such as that which occurred lately at the Calumet and Hecla mine, where ten men were killed by the overwinding of a cage, consequent breakage of the cable-couplings, and fall of the cage and men back into the shaft mouth and to the bottom, is now a very rare occurrence. An immense amount of mechanical ingenuity has been brought to bear upon the hoisting problem, and any one who has studied the most advanced practice cannot fail to be impressed with the results. There are now three-decker cages capable of carrying twenty-four to thirty men, and running safely at considerable speed; there are safeties against falling; automatic chairs; detaching hooks and automatic throttles to prevent overwinding; powerful brakes, controlable and automatic; position indicators and alarms; safety hoods; flat-woven and round-tapered steel-wire cables of the finest material and workmanship; balanced cages, tailropes, etc.; and, in short, almost every imaginable device to insure the safety of the men, except an efficient guard against their swaying out and being caught by the timbers, which is now the most fruitful cause of cage accidents, and which seems difficult to adopt without interference with convenient working. The accidents which do occur are mostly attributable to carelessness, just as with the passenger elevators. The mine-cages cannot have the same safety devices as the elevators, nor have they marquetry sides and parquetry floors, plate mirrors, plush sofas, tapestries, rugs, flowers, and tinted incandescents; but, allowing for difference of conditions, as just suggested, they are fairly satisfactory, both as to efficiency and safety.

In an incidental mention of iridium metallurgy, in a paragraph which appeared in this Department in the June issue, unintentional injustice was done by the omission of mention of the work of Mr. John Holland, of Cincinnati, who, after eighteen years' study and experiment and a large expenditure of money, succeeded in 1882 in fusing the metal with phosphorus in a common draft furnace. Since then Mr. Holland has melted as much as twenty ounces in one crucible at a time, and molded it as easily, he writes, as silver or gold. This of course does not detract from the credit due Professor Dudley, who became associated with Mr. Holland, and who discovered the method of electroplating with iridium and made valuable researches on the behavior of the formerly so refractory metal.

Near Crescent City, on the coast of northern California, a plant has been put up for the electro-magnetic separation of iron ore from the black sands of the beach. It is expected to handle 1000 tons of sand daily, and it is claimed that the crude sand carries 10 per cent. iron, which would give a product of nearly 100 tons of pig daily when smelted. Similar operations in other places have been only partially successful, but the black sands of the Pacific coast are unusually plentiful and rich. We would have more faith in the present venture if it were not yoked to a somewhat mysterious smelting process.

The Carson mint, which was closed for coinage on June 1, is one of the most modern and best-equipped plants of its kind in the world. It was established for the purpose of handling the Comstock bullion at a time when the output of the lode was large enough to warrant it. The

latest policy of the treasury department has been to concentrate the refining and coinage of bullion at a few principal points, leaving the "branch mints," so-called, to serve as depositories and assay offices for amalgam, dust, and gold and silver bullion.

It has always been recognized that for desulphurizing and chloridizing ores no better work could be done than in the long hearth reverberatories. But these, when operated by hand, while giving a dead roast or a high degree of chloridation, are slow, of low duty, and require much labor and consequent expense, while their efficiency depends largely upon the skill and faithfulness of the manipulators. The O'Harra mechanical reverberatory, introduced many years ago, was an attempt in the right direction, to place the old reverberatory on a level with the revolving shaft and shell roasting furnaces by substituting mechanical stirring appliances for hand rabbling. These were plow-stirrers drawn by a chain over the double hearths; but certain disadvantages were due to the friction of the stirrers on the brick floors and the injurious effect of the heat and sulphurous fumes upon the mechanism. Now important modifications have been introduced in a new form of furnace, called the Brown-Allen O'Harra, in which the carriers are wheels running upon iron rails at the sides of the furnace and to a great extent protected from the heat and fumes of the working hearth by slotted brick partitions. The stirrers are moved by a transverse rigid traveling bar, which holds them just clear of the hearth floor. Thus the friction is much reduced, the iron mechanism fairly protected, and the duty of the furnace correspondingly increased.

MOVEMENTS are on foot in various localities in the Western mining regions and at points near new mining districts to build lead-smelting plants, and not always with the soundest judgment. The history of the many ill-considered attempts at lead-smelting for the precious metals at badly selected sites in the past ought to serve as a warning. The successful plants of this kind are for the most part placed, not at or even very near the mines, sometimes indeed at very long distances from them. Their sites have been chosen with reference to the best total average of all the conditions of transportation, supplies of ores, fuel and flux, and markets. The most economical and proportionately best-paying works are also conducted on the very large scale necessitated by sharp competition. To attempt to establish smaller plants at places where only one or two out of the many basal conditions are favorable—say proximity to the ore-supply, for instance—is a very hazardous undertaking. Even as to ore, quantity alone is not sufficient for successful working, unless in the improbable event of a continuous supply of neutral or easily fluxed ore. Success depends upon skilfully adjusted combinations and mixtures. Lead-smelting for the precious metals does not stand on the same basis as copper-matte smelting or the pyritic-smelting processes, which aim simply to turn out an unfinished material for shipment to better placed works for further reduction, and should be rather viewed as concentrating methods. It is a most complex industry, requiring not only large capital but also the highest technical and commercial skill and forethought in taking advantage of existing conditions. Of all the many considerations to be taken into account in planning new works, the question of site is or ought to be the most decisive. Unfortunately the indications are that this crucial point is not always clearly appreciated, and possibly there may be from this cause a temporary retrogression in silver-lead metallurgy.

IN a contribution to the *American Antiquarian* Mr. R. L. Packard presents the results of an extensive investigation into "Pre-Columbian Copper Mining in North America," and brings together all the evidence from the records of early explorers, Indian traditions, personal observation and that of other recent observers, summing it up for the first time from a combined archæological, mining, and metallurgical point of view. There is no reason

to believe that the old copper miners were of very remote antiquity or possessed of extraordinary skill and a relatively high degree of civilization, as has been often claimed for them. The northern Indians had no knowledge of smelting ores (as did the Aztecs) or even of melting and molding the native metal, but were content to hammer into shape such piece of native copper as they could find. Still less were they acquainted with bronze. The total stock of aboriginal copper ornaments, implements, and weapons was very small. "Modern miners," Mr. Packard says, "would consider the whole system nothing more than prospecting, and not mining proper, as there were no shafts or tunnels or underground workings of any kind." As Mr. Whittlesey expressed it, "the old miners performed the part of surface explorers." Mr. Packard remarks that "native copper occurs in small quantities in many places in the United States, but there is no evidence at present that the northern Indians had knowledge of any but two localities where it could be obtained in any quantity. These were the Coppermine river in the British possessions and the Lake Superior district. The latter affords the most remarkable occurrence of native copper in the world."

WHAT is the Armstrong hoister? That is a question which puzzled a mining man who thought himself fairly posted on mining machinery. He was somewhat abashed to find it to be simply the hand-windlass of antiquity. The expression is not very common, but it is good.

The writer remembers once asking quite innocently, on reading an account of a mining accident, how it happened that "scales" should be allowed to fall down a shaft and kill men working at the bottom. He has not yet recovered from the answer and the laugh provoked by that inquiry.

There is a gold-mining district out West where the ore is partly free and partly auriferous sulphides. The miners there call everything "tailings" that passes the battery and plate amalgamation, including the concentrates, which are often the most important portion of the product. It is not a little astonishing to outsiders to hear or read in the local production returns of "tailings" worth $30 and $50 a ton being shipped to the smelters.

Several good glossaries of mining terms have been prepared, but it is impossible to compile in them all the current local expressions and keep up with the new ones. A man who should try to learn them all would find that he had undertaken a large contract. In American mines may be found miners of every nationality, representing a multitude of districts and bringing with them their own peculiarities of habit and diction. The mining vocabulary borrows from all sources indifferently,—Cornish, North of England, and other dialects of Great Britain; from the Hartz, because so many of our engineers have been educated in Germany and because German mining literature has had so great influence; from Spanish-American countries, since in the early days of silver-mining in the United States the Mexicans and Chilenos were regarded as authorities; and in less degree from other foreign sources. In general, there is a broad distinction between the terms used in coal-mining and those common in metal-mining. But, besides all this, almost every camp offers some original localisms of its own, while novel circumstances and new appliances constantly enrich (and confuse) the vocabulary with fresh additions. Probably few miners unfamiliar with the Comstock could guess what sort of thing a "buckboard" is, or a "giraffe," and it would be possible to pick out scores of similar conundrums from local usages. Without going into foreign words at all, the English language (or rather this subdivision of it) contains enough mining synonyms and odd expressions, in common use in one or another of the many districts of the old country, the United States, and Australia and the other colonies, to be sufficiently bothersome, and also instructive as showing what twists a language is capable of.

"THE Mineral Industry, its Statistics, Technology, and Trade, in the United

States and Other Countries," is the title of a recent book compiled by Mr. Richard P. Rothwell, editor of the *Engineering and Mining Journal*, of New York. It is designated as Vol. I. of a proposed annual series, and carries the statistics or estimates down to the close of the calendar year 1892. The book is a large octavo of 628 pages. Its title sufficiently indicates its scope, which is an extension of the annual reviews of the mineral industry previously published in special editions of the *Engineering and Mining Journal*, issued early in each year to cover the history of the preceding year. In the statistics Mr. Rothwell has brought together the results of the eleventh census, the work of the geological survey, the bureau of statistics of the treasury department, the bureau of the mint, the Iron and Steel Association, etc., with modifications; and for 1892, in addition to the usual and generally accessible trade reports for iron, steel, anthracite, quicksilver, petroleum, and the gold and silver statistics of the mint officials, has added the results of an extensive original canvass of the various branches of the industry. Among the names of the gentlemen credited with the preparation of separate chapters are those of several well-known specialists. The enterprise shown in undertaking a publication of this magnitude is highly commendable, and the comparative promptness with which the results have been presented to the public is especially creditable.

Simultaneously with the issue of "The Mineral Industry" appeared "Mineral Resources of the United States," for 1891, the eighth volume of the series prepared by the Division of Mining Statistics and Technology of the United States Geological Survey—an octavo of 630 pages. While it is fair to state that the production figures compiled for 1891 by the Geological Survey have been before the public for many months in the shape of advance bulletins and statistical charts, it cannot but be regretted that the publication of the complete report was so long delayed. It has had the advantage of better facilities, the prestige and authority of a government work, and better (though still insufficient) means in money and men to carry out the necessary canvass than obtain with a private undertaking. *Per contra*, it has suffered from and been impeded by the inevitable drag of officialism and red tape, and doubtless also by dilatoriness in the government printing-office. To get out a government report with any reasonable degree of promptitude is no easy task; and to attempt it means nothing short of a single-handed fight against the whole United States government and the incurring of the resentment of every official from top to bottom whose customary routine repose has to be disturbed. But it *is* possible, as has been practically demonstrated, to issue the full production returns on or a little before July 1 of the year following that considered, and to have the manuscript of the complete report in the hands of the printers at the same time, the published volume appearing early in the autumn.

The annual report of Mr. E. O. Leech, the Director of the Mint, on "The Production of Gold and Silver in the United States" for 1892, was noticed in the June number of this Magazine. Of all the statistical tasks of the kind, that of procuring the production figures of gold and silver in this country, and of putting them together in such manner as to best meet the conditions, is perhaps the hardest. In those countries where there are official mine inspection and compulsory returns of working results it is a simple matter, amounting to a mere clerical adding up of returns. Here it is a very complex and difficult one, and of the different ways of attacking it the statistician has to choose the most satisfactory or least objectionable plan, which is usually a compromise between the hopeless canvass of the thousands of individual ore-producers, and the short cut, by means of the refineries, the coinage, and a comparison of exports, imports, and consumption in the arts. Mr. Leech, as was to be expected, has met with some adverse criticism as to method, but deserves the hearty approbation of the people for the painstaking and conscientious care he has shown in undertaking a rather thankless task.

COMMENT & CRITICISM.

A Great Work in Sculpture.

AS an admirer of sculptural art, it has been a source of special gratification to me to observe the lively interest which THE ENGINEERING MAGAZINE has always manifested in our development in that direction. It has seemed to me specially appropriate that you should stimulate public interest in the subject, for it is manifest, that if American architects and engineers, together with the capitalists and men of affairs who are their patrons and associates—in short, if "the captains of industry" can be aroused to an appreciation of the sweetness and beauty that sculptural art can lend to daily life, and beyond that, the cash profit that is sure to follow an intelligent application of the art to the great structures that we are building, and to public parks and public places everywhere, we shall indeed attain unprecedented progress in that branch of art wherein America is as yet wofully deficient.

By reason of your interest in the subject, therefore, I am prompted to ask your special attention to what I regard as one of the greatest pieces of realistic sculpture that has ever yet been given to plastic art, in this or any other country. I refer to the bronze group designed to commemorate the massacre of old Fort Dearborn, on August 15, 1812, which has just been completed here by Carl Rohl-Smith, and which is now in the molds at the Henry Bonnard bronze foundry in New York. The idea of commemorating this historic event originated with Mr. George M. Pullman, and through his munificence the city of Chicago is to be presented with what has turned out to be a work of really great artistic and historic importance. Enclosed herewith I hand you a front view of the group, taken just after it was modeled in clay, and I trust that you may find place for it in your pages.

The monument will mark the scene of the tragedy, at the junction of Eighteenth street and Calumet avenue. It consists of a group of five figures, illustrating the rescue of Mrs. Helm by Black Partridge, the historic Indian chief. The representation is based upon Mrs. Helm's own version of the incident. The group is finely symmetrical in composition, the figures full of robust action, showing in the technical handling admirable strength and vigor and an intimate knowledge of anatomy. The sculptor made a conscientious and faithful study of the Indian from living models, obtained through the courtesy of Gen. Miles. His red men are therefore not Caucasians with feathers in their hair. He has grasped with remarkable readiness and insight the picturesque and plastic possibilities of the subject, and every line of these figures expresses the aborigine as distinct from the white man. The peculiar physique, movements, and attitudes of the Indian are forcibly suggested, the salient racial traits being expressed with a perfectly fearless realism, which however never merges into exaggeration.

The pedestal upon which the group will rest is to be ten feet high and measures 13′x9′ 11″ at the base. On this pedestal will be four bas-reliefs telling the story of the massacre, the first on the front showing the evacuation of the fort, and that on the opposite side the attack on the caravan. These are to be 7 feet by 2 feet 5 inches. The bas reliefs on the ends will depict the return of his medal by Black Partridge, and the heroic death of Captain Wells.

On the evening of August 14, 1812,-Black Partridge went to the fort, and entering Captain Heald's headquarters said: "Father, I came to deliver up to you the medal I wear. It was given me by the Americans, and I have long worn it in to-

ken of our mutual friendship, but our young men are resolved to imbrue their hands in the blood of the whites. I cannot restrain them, and I will not wear a token of peace while I am compelled to act as an enemy." This is the moment chosen for plastic representation. The scene is the interior of the fort where the men are loading the wagons, showing on the left the men and women at work; on the right the corner of the block house, the figures of Captain Wells, Captain Heald, Black Partridge, and the accompanying Indians.

Captain Wells, having fought valorously on the day of the massacre, killing seven Indians in the fight, came up to Mrs. Heald, and both were overtaken by a party of red men. His horse was shot, and he being wounded fell under the animal in such manner that he could not extricate himself. He rose to a sitting posture and called to the enemy to "shoot away." This is the stirring incident embodied in the second of the smaller bas-reliefs.

But enough has been said to indicate the striking and realistic character of the work. I conceive that its lasting value and merit will consist in the faithfulness with which the native American Indian—in feature, form, character, costume, and methods of warfare—has been preserved to us in lasting bronze. D. H.

Chicago, May, 1893.

NOTE.—A portrait of the sculptor and references to some of his other works will be found on pages 440 and 442 of this issue.—THE EDITOR.

The Advantage in Finely-Ground Cement.

REFERRING to the extract in the April ENGINEERING MAGAZINE (page 126) from Mr. Carey's paper on cement, presented to the British Institution of Civil Engineers, the statement that the residue left in a sieve with 32,257 meshes per square inch had no cohesive properties might lead some engineer or architect (not conversant with the cost of grinding) to specify for use in his work cement ground so fine that all or a very large percentage would pass through a sieve of this character.

For the benefit of any who might be inclined to ask for a cement of this fineness, I would say that Mr. Carey makes too broad an assertion when he states that a residue of this kind has no cementitious value. The extra cost of grinding to produce a cement that will pass through a sieve with 32,257 meshes per square inch would be considerable. It is a question whether 50 per cent. would cover it, and, as I will try to show further on, it is not likely that anything would be gained by the expenditure. There is no doubt that a sieve with 2500 meshes per square inch is not fine enough to use to get the best result from a cement, but very few manufacturers now use this sieve as standard, except the English.

The works with which I am connected use a sieve with 6400 meshes per square inch as a standard, and do not send out any Portland cement that has over 5 per cent. residue left on this sieve. The German manufacturers' standard is 5776 meshes per square inch. The residue remaining on a sieve with 5776 meshes per square inch, or a sieve with 6400 meshes per square inch, even if it has no setting qualities when used alone, will, in connection with the fine cement, sand and water, become disintegrated and be as useful as the fine cement. The chemical action of the water, etc., will, during the setting and induration, act on these coarser particles and make them perform their share of the work. This can be seen in the fracture of a briquette made from coarser-ground cement. The fracture will have a smooth appearance, and no signs of the coarse or sandy particles. If a cement is of the proper composition, well clinkered and ground so fine, there will not be a residue of over 5 to 8 per cent. left on a sieve with 6400 meshes per square inch, or 10 to 15 per cent. On a sieve with 10,000 meshes per square inch you will get a perfectly reliable cement, as well as the most economical one to use. Grinding cement any finer would be costly and unnecessary. Increase in cost of production naturally means an increase in the selling price. Then the question arises whether the consumer had not better pay for the residue in the cement than be compelled to pay considerably more for a ce-

ment all passing through a sieve with 32,257 meshes per square inch, or even with 20,000 meshes per square inch. Some people may say that with a very fine cement one part more sand can be used, which may be true, and that is the reason we adopted the sieve with 6400 meshes per square inch as our standard sieve, in place of the one with 2500 meshes per square inch now used in England; but the addition of sand has a limit. I question whether any competent engineer will allow a much larger proportion of sand than three to one on responsible work, while the proportion of crushed stone, etc., will be influenced by the size and quality.

A cement may be strong enough to stand six or even ten parts of sand to one part of cement, yet theoretically in any cement work all the voids are expected to be filled up, and in a mixture of six to one I am sure there is not sufficient cement to do this. This fact limits the sand dose, and without being able to increase the sand dose there will be no necessity or advantage in having the cement ground finer than it is now ground in the German or Saylors Portland mills.

The extract from Mr. Carey's paper goes on to state the tensile strength of cement with 9 per cent. residue left on a sieve with 2500 meshes per square inch and the increase in strength after the residue is taken out. This of course is true, but no engineer in the country is obliged to use a cement so coarse. Several companies manufacturing Portland cement in this country grind their cement to a degree of fineness never attained by the English manufacturers. In fact almost all the American Portland cements are being ground finer than the English cements.

There is much room for the English people to improve in grinding. At the same time, to go from one extreme to the other,—*i. e.*, from a sieve with 2500 meshes per square inch to a sieve with 32,257 meshes per square inch,--in determining whether cement should be accepted or rejected, would be a mistake. The United States and Germany are young in the manufacture of Portland cement, when compared with England, yet the manufacturers in that country have much to learn that their younger and more progressive rivals have already acquired.

Any engineer or architect can to-day get a Portland cement manufactured in this country superior to the English and on a par with the best German cement.

WILLIAM G. HARTRANFT.

Philadelphia, April 24, 1893.

A Protest From A Colombian.

MR. CHARLES P. YEATMAN'S paper entitled "Would the Pan-American Road Pay?" published in the April number of this Magazine, I read with deep interest, being myself a Colombian and interested in one of the branches of the engineering profession.

Before reading this paper several times, and examining carefully the accompanying "pictures from the countries traversed," I could scarcely have believed that such misleading statements could have been found in a publication of the high standard of The ENGINEERING MAGAZINE, and from the pen of a civil engineer now a guest of the country misrepresented. Realizing the evil effects that some paragraphs of this paper may engender in the minds of capitalists, manufacturers, and the people at large, in foreign countries interested in Colombia, I take the liberty of presenting some remarks on this subject.

After three years spent in the United States, during which time I have met scientific men and professors, men of affairs and manufacturers, merchants, miners, and laborers, from New England to the Pacific coast, I have learned a lesson never dreamed of before my arrival in this country. It relates to the almost universal ignorance of the geography and history of Latin America, and of its social and political standing in the civilized world. Probably not more than one in a thousand citizens of North America could give on short notice more than the following information concerning Latin America, if we except, perhaps, Mexico:

1. South America is a *country* situated *down* in the tropics, and exceedingly warm, where whites cannot live.

2. It is made up of little States not independent of each other; how they are divided up for the administration of the government is not known.

3. The inhabitants are scattered in small *pueblos*, living in primitive fashion on the spontaneous products of the land. They are mostly Indians and half-breeds, the only enterprising people there being "the Americans" with their "push, ingenuity, and superior intelligence."

4. The people care only to fight and quarrel, and their main business is to kill each other as savages.

5. The natural products are coffee, sugar, and fruits, such as are used in the United States every day, and also monkeys and snakes.

6. The women have black eyes and black hair, and are pretty, and play the guitar, and sing and dance "fandangos," and are kept out of range of the men, within iron railings.

8. In conclusion, it is a great and rich country, waiting for American push and ingenuity, and a good prey for Uncle Sam when he sees it fit and ripe.

It is not my intention, however, to indulge in recriminations. Besides, this ignorance concerning my own country does not exist alone in the United States. It is even worse in Europe, except that the merchants there understand their business better, and carefully study the people of South America and their needs.

It is clear that business transactions between two countries cannot be safe without a mutual knowledge of the parties engaged. If the United States wishes to trade with South America, let it be known here what the people there really are, and what they need, and I venture to predict results far more satisfactory than those from any "reciprocity" schemes devised by politicians. Let the North Americans more generally follow the example of the far-sighted New York merchant who some time ago sent his son to a South American capital to be educated, instead of sending him to Harvard to learn dead languages.

But, coming to Mr. Yeatman's article, I feel that it would be better for us to remain as naught in the mind of the North American people than to be so grossly misrepresented as has been done in his work. I quote:

"The reader who will study the illustrations in this paper, all of which faithfully portray types of natives in the countries to be traversed by the proposed Pan-American route, and their occupations and means of support, will be more strongly convinced than he could be by words alone of the lack of local traffic which such a railway would experience."

Again:

"That tropical country is too sparsely settled, the people have too little need for exertion, and the governments are too unstable, to justify the risk of capital in any such venture. Reference may again be made to the pictorial arguments accompanying this paper, which can hardly fail to convince any but enthusiasts how unpromising is the field and the people for the building of an expensive railway."

It may be noticed that he gives pictures from only one of these countries,—Colombia. Under a picture of some Indians is written: "Types of the people through whose country it is proposed to construct the Pan-American railway." To a starving donkey he gives the glory of being "now considered (?) a satisfactory means of transportation by the natives." In his opinion the train of pack bullocks is the "transportation means now suited to native needs." As a faithful representation of the cities of Colombia he chooses Puerto-Berrio (!) and seems well satisfied, as well as with his type of "a neat little home in Colombia." These are not all the criticisms that might be made of the pictures, as there are several other views of a similar character.

No doubt every Colombian will feel complimented by this portrayal of his country, though I fail to see the glory in ridiculing a young nation striving to better her condition under trying circumstances,—fighting nature, contending with internal difficulties, and handicapped by foreign prejudice. The pictures referred to are correct of the people they represent, but to give them to the world through the pages of a serious magazine, as a result of nine years of experience of a professional man, as representing the country and its

aspirations, cannot be otherwise than injurious.

One thing that pleased me, however, was to see Mr. Yeatman giving his fellow-citizens an account of the natural difficulties to be encountered in the building of a Pan-American road, and the probable—yes, certain—failure of any such enterprise for many years to come. That difficulties exist in railroad building in the tropics I am ready to grant to the utmost.

In conclusion, however, I may express my doubts of the "crooked isthmus of Panama and the country immediately south of it" being the "Gordian knot of the Pan-American problem." At least there is nothing in Mr. Yeatman's paper to prove it, as he only speaks of Colombia, and the projected road would cross many a country from Mexico to the "Gran Chaco," or the deserts of Alacama and the Chilian Cordilleras.

JUAN DE LA C. POSADA,
Mining Graduate, University of California.
New York, April 7, 1893.

[IT is proper to state that the paper written by Mr. Yeatman and published in the April number of this Magazine was not intended to be accompanied by the illustrations which he had also sent to this country. The use made of his material, however, was sanctioned by those in whose hands they were placed, both as to the introduction of the pictures and the addition to the text of references to them. If, therefore, any resentment should be felt by Colombians on account of what has been published, particularly if it is felt that any misrepresentation has been made, it will not be fair to hold Mr. Yeatman responsible.—THE EDITOR.]

Some Ancient Windmills.

IN the article on windmills in the February number of this Magazine the writer made the statement that the ancients have given us no indications that they were familiar with that venerable and still useful prime mover, and that it is not mentioned in "the famous work of Hero, in which the first steam-engine is described." This proves to be a mistake, and Mr. W. F. Durfee kindly calls my attention to the error in the following interesting and instructive statement:

"I have three editions of Hero's Spiritalia, viz.: Commandine's (Latin) 1575; Aleotti's (Italian) 1647; and Bennett Woodcroft's (English) 1851. In each of these editions is shown and described *a windmill blowing an organ by a plunger air-compressor*. In Commandine's edition the connection between the windmill and compressor is not at all clear in the cut. In Aleotti's the axis of the windmill has a crank on it, which is coupled to the plunger by a connecting-rod. Woodcroft shows a disk on a windmill shaft, armed with a number of pins, or tappets, which operate on one end of a lever, whose opposite end is coupled to the plunger of the air-compressor."

I have verified this statement and am surprised that I should have overlooked this singular combination of devices in a work with which I was reasonably familiar. The readers of the Woodcroft edition will find it at page 108, article 77. The windmill has four vanes, and is shaped very like the modern mill.

R. H. THURSTON.
Ithaca, N. Y., April 1, 1893.

More Facts About Immigration.

UPON reflection it will appear that the recent appearance of an article upon immigration in THE ENGINEERING MAGAZINE was not wholly incongruous. A happy way out of difficulties that seem formidable may sometimes be most readily found by some kind of engineering. The difficulties of which Colonel John B. Weber treats in the April number of this Magazine do not seem so great to all as they appear to be to him. Much depends upon the standpoint of observation. It is not uncommon to search, at a distance, for remedies, and overlook those which lie close at hand. Often the latter are even better than the former. When the late civil war closed, nearly five millions of *freedmen* were added to the population of the United States. These millions were English-speaking people, many of them familiar with our constitution, history, and laws. All of them

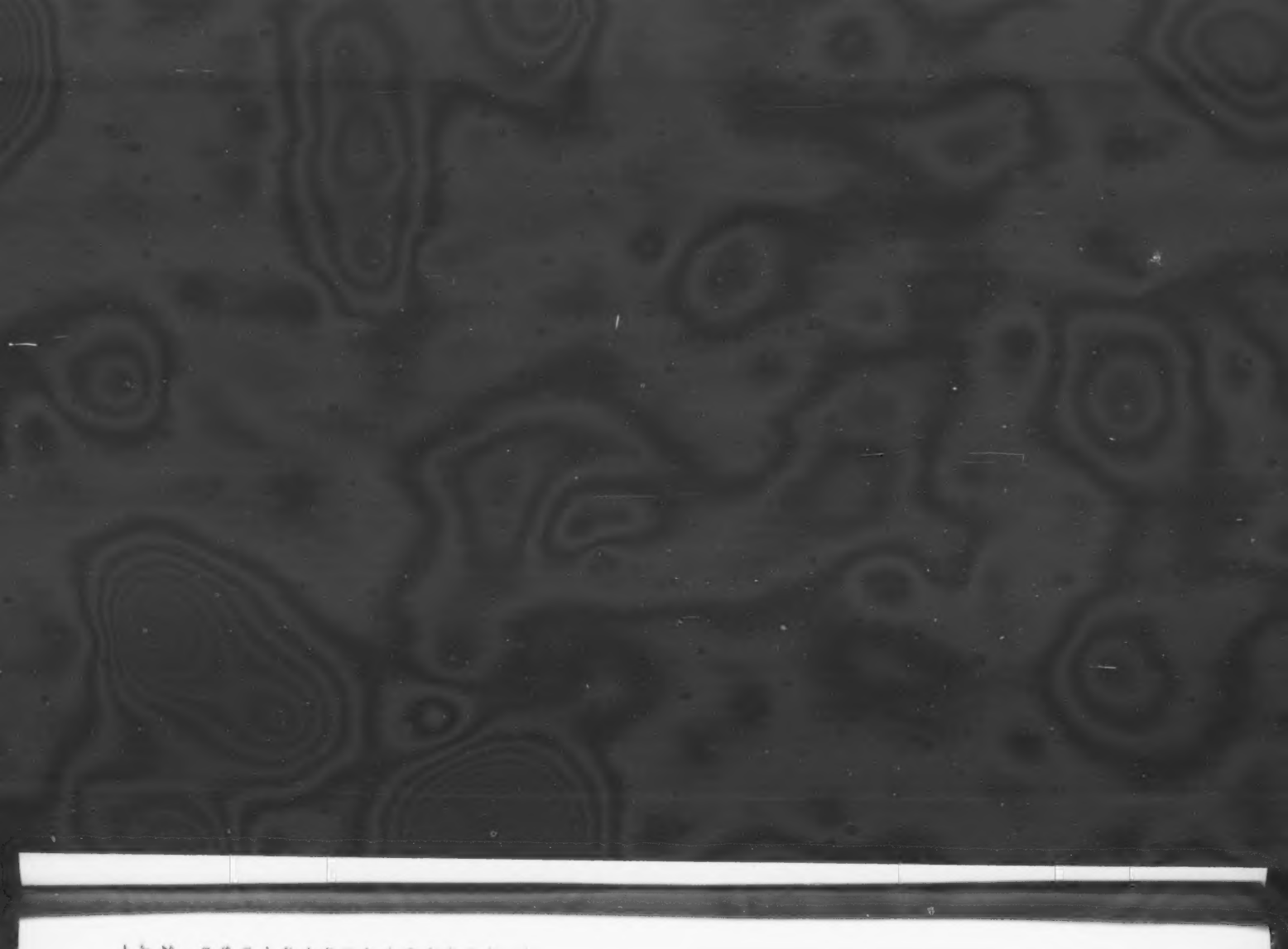
were, in some form, acquainted with our industries, whether we speak of households, factories, farms, or mines. We were not then, and are not now, dependent upon Europe or upon any other place for an immediate supply of "privates" for our industrial army in order to develop our mines of coal and iron, "level our forests and plow our fields," to quote from Colonel Weber.

The 5,000,000 of freedmen of 1863-65 have increased to nearly twice that number, and we are under obligations to them, as our own citizens, speaking our language and introduced by us to citizenship which they had earned, partly by fidelity and partly by valor, that we are not under to foreigners who seek our shores largely as a refuge from intolerable distress or painful environment. This debt we cannot safely ignore as a nation. Nor ought it to be neglected while we are indulging the "sentiment" of making "an asylum" for distressed foreigners, which, within proper limits, we ought to continue to do. *Enlightened liberty for the world* is a better "sentiment" than "Liberty enlightening the World," in my judgment.

The trend of Colonel Weber's article is in the direction, in part, of orders and grades and classes, which are more in harmony with the aristocratic atmosphere of the kingdoms and empires in Europe than with the democracy of our republic. I hope my desire to give due prominence to the justice and equities involved in this matter will not be obscured by prejudices of race or nationality. While some nations are competing for a leading place and position on the largest continent of the world, I sincerely desire that we may perceive the conspicuous advantage that Providence has given to us by making or permitting us to be the temporary guardians—may I not say sponsors?—for so large a number of the legitimate heirs of Africa.

WM. W. CAMPBELL.

Wilmington, Del., April 17, 1893.



There is an apparent discrepancy at this point.

The pages are either missing or the pagination is incorrect.

The filming is recorded as the book is found in the collections.